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The JOURNAL appears eight times a year—monthly with the exception of June, July, August, and September.

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art. = article; rev. = review; br. = brief (periodical literature); e. c. = editorial comment; n. = note.

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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

SITE DETERMINATION AND YIELD FORECASTS IN THE SOUTHERN APPALACHIANS[1]

By E. H. FROTHINGHAM

Studies in the Southern Appalachian forests have been handicapped by the complexity of the forest types and sites, and by the lack of any satisfactory classification of them. While certain general resemblances in composition are recognized—"hemlock type," "poplar type," "chestnut oak type," for example—these have not been correlated nor subdivided on the basis of site, so that data secured in one region can not well be applied to an apparently similar combination or "type" in another. There are also many intermediate, poorly defined combinations which must be dealt with but which are difficult to assign in a conventional type classification. The one generally used classification—into cove, slope, and ridge "types"—is adapted to estimating purposes in land acquisition, but not to the forecasting of yields nor to other purposes of management.

The purpose of this paper is to outline a simple method for classifying the southern upland hardwoods (the poplar-oak-chestnut types) in terms of site as determined by the height growth of indicator species. The method is believed sufficiently well supported by field data to justify its adoption as a practical system for southern upland hardwoods, considered as individual species or in combination in different types.

SELECTION OF A BASIS FOR CLASSIFICATION

"Cove," "slope," and "ridge," as used by the Forest Service to designate "types" in estimating, are distinguished by differences in the merchantable length. "Cove type" designates stands producing three

[1] Read before the Washington Section of the Society, November 18, 1920.

or more logs per tree, "lower slope" two logs, "upper slope" one log, and "ridge type" no saw timber. The use of a measure of height in classification is thus not an entirely new and untried idea in this region. This basis, however desirable for estimating, fails to classify sites in terms of productivity, at least in the detail necessary for management. Within a single type the age and average or dominant height of the timber have, however, long been used for classifying sites. Professor Roth's [2] suggestion of a general site classification on the basis of height made it appear possible to go beyond this and prepare a single system of site classification, useful for immediate needs, to be applied not to individual types but to the forest as a whole.

The plan proposed by Roth involves the recognition of certain "standards," each representing a group of species which reach closely similar heights at a given age (100 years is suggested by Roth). Tall species, like "the Pacific coast giants on their native sites" would fall in "Standard a"; "Standard b" would include, among hardwoods, "yellow poplar, chestnut, black oak, red oak, and probably most of the good hardwoods in southern Michigan and the Ohio Valley"; the hardwoods falling in "Standard c" would include "white oak, hickory, yellow birch, sugar maple, beech in northern woods." Each standard would include a number of sites, which Roth would number from I (best) to IV (poorest), based upon the height attained at 100 years by the species representing the standard when found under different environmental conditions. Although Roth's plan contemplates a country-wide classification on broad lines, the general idea of site classification upon the basis of height which it suggested appeared to furnish a good working basis for a classification of the Southern Appalachian forests. Plans were accordingly drawn up and field work undertaken in the summer of 1917 by the writer and Russell Watson.

THEORY AND METHOD OF THE STUDY

It has been customary to regard site as a subdivision of type. The point of view of this study was the reverse; a given "site" was regarded

[2] "Concerning Site," by Filibert Roth. For. Quart., March, 1916, Vol. 14, No. 1, pp. 3-12. See also:

"Site Determination, Classification, and Application," by Russell Watson. Jour. of For., May, 1917, Vol. 15, No. 5, pp. 552-63.

"Height Growth as a Key to Site," by E. H. Frothingham. Jour. of For., Nov., 1918, Vol. 16, No. 7, pp. 754-60.

"Jack Pine," by W. D. Sterrett. U. S. Dept. of Agr. Bulletin 820, pp. 16-18, 1920.

as capable of producing different composition types, and two "sites" might contain the same composition type, differing primarily in the rate of growth. The "site" classification cuts across type lines. As between the old Acquisition "types" of cove, slope, and ridge, there are general differences not only in merchantable length but also in composition; but the differences in composition are not such as to designate true types. Cove, for example, may contain poplar type, hemlock type, or any of a variety of mixtures, while the limits set by merchantable length in defining the Acquisition "types" may seldom coincide with the limits of composition types. In the "site" classification scheme here presented, if the southern upland hardwoods as a whole (the oak-chestnut poplar association) were regarded as a single type, the "sites" would become sites in the generally accepted sense.

It was the original plan to identify and classify in a single numerical series all sites within the range of chestnut in terms of the height of this species when mature or at the age of 100 years, as prescribed by Professor Roth. It was hoped that chestnut would furnish a single, generally applicable standard, to which the height growth of other species could be referenced and made a means of identifying the site even when chestnut was absent. It was soon evident that the limitations thus imposed were too severe; a classification based upon chestnut alone would be useless in the absence of chestnut from the stand, while one based upon old trees alone could hardly be applied in terms of young trees. So while chestnut, because of its abundance and wide distribution, was made the principal index, other species were also used, notably yellow poplar and scarlet, red, and black oaks. The characteristics which especially fit a species for the purpose are rapid growth and intolerance, which limit the irregularities in height growth possible as a result of suppression. Normally developed "mature" trees of practically all species were also measured as indicators, the age being usually roughly estimated from the diameter.

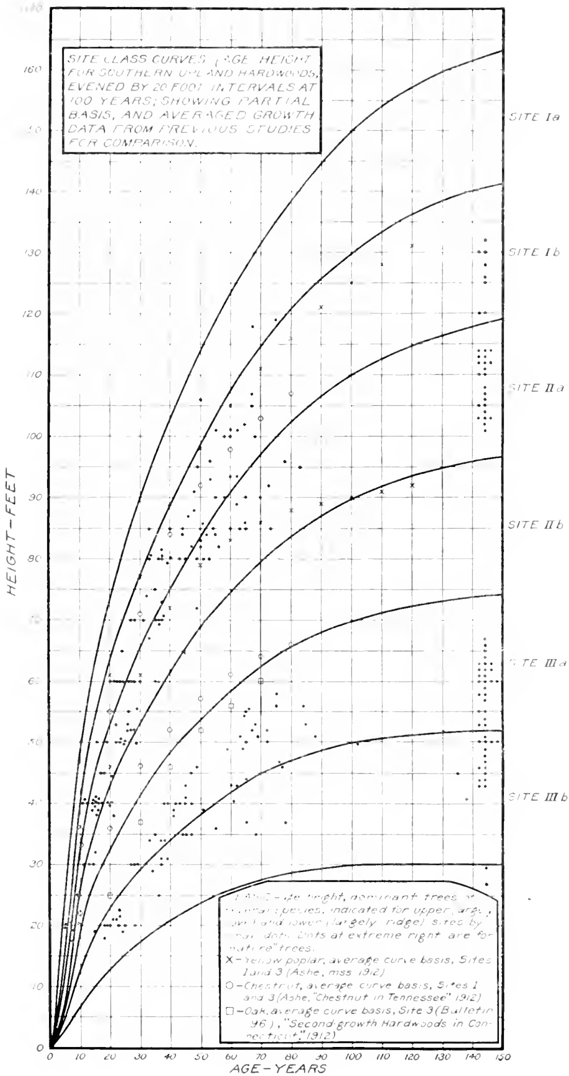
[3] In the case of large trees of slow-growing species a rough estimate based on diameter was considered sufficient in judging "maturity" (as to height growth). "Maturity" as used in this paper relates only to the cessation of rapid growth in height, and applies safely to trees of 150 years or older in the coves and lower slopes and 100 years or older on the ridges and upper slopes. As a matter of fact these age limits are probably greater than necessary; subsequent studies of height growth will quite likely lower them for practical purposes. They vary, of course, with the species. As a check upon the estimates of height growth maturity intensive height growth analyses at the top of "mature" and "doubtful" trees were frequently made in the course of the study, the top 5 or 6 feet of the stem being sectioned in 1-foot or 6-inch lengths and the ring counts recorded for curving.

The field measurements were made at stations representative of different conditions of composition and height growth, usually at intervals along profile trips over ridges from cove to crest, or on trips confined to coves or ridges. At each station determinations were made of the age and height of healthy representative dominant trees of the important timber species, both "immature" and "mature" (as to height growth). Chestnut and other intolerant species previously mentioned were the principal subjects of measurement, but old and even young trees of more tolerant species, such as white and chestnut oaks, hickories, black gum, pines, hemlock, etc., were commonly measured for comparison with chestnut. The average height of "mature" trees which have practically ceased their height growth was considered a sufficiently good indicator of the quality of site, at least for the broad limits which were considered suitable for practical purposes. Every chance to secure height growth data on young dominant trees of various species, however, was utilized and in many cases sectional age counts were made at several points on the stem. The results of the field work were finally compiled in 35 "trips" representing conditions on and near four National Forests,[4] and comprising a total of 145 stations, 419 sample tree measurements (many of them growth analyses), and 21 sample plots.

CLASSIFICATION OF THE DATA BY MEANS OF HEIGHT—AGE CURVES

To identify a site in terms of any age class on an area, a set of height growth curves was indicated. Each site would then be represented by a curve of the height growth, in terms either of an "average" site classification considering all species dominant in the crown cover, or of a "standard" classification for a particular species or group of species, in accordance with Roth's plan. In compiling the field notes, the "standard" plan in terms of chestnut was first tried. The heights of all the dominant chestnut trees measured were plotted on the basis of age, limiting curves were drawn, and the points were segregated by interior curves into three equal height classes designated, from best to poorest, as "Sites I, II, and III." This constituted a "standard" system for chestnut alone. The "average" plan then suggested itself, and the heights of all the dominants of *every* species measured at the same stations at which the chestnut measurements were taken, together

[4] The White Top (Virginia and Tennessee), Pisgah (North Carolina), Georgia (Northern Georgia), and Monongahela (West Virginia).


SITE CLASS CURVES (AGE HEIGHT) FOR SOUTHERN UPLAND HARDWOODS, EVENED BY 20 FOOT INTERVALS AT 100 YEARS; SHOWING PARTIAL BASIS, AND AVERAGED GROWTH DATA FROM PREVIOUS STUDIES FOR COMPARISON.
HEIGHT – FEET
AGE – YEARS
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
SITE Ia
SITE Ib
SITE IIa
SITE IIb
SITE IIIa
SITE IIIb
indicated for upper, average, and lower (largely ridge) sites by
Dots at extreme right are for
trees.
X – Yellow poplar, average curve basis, Sites 1 and 3 (Ashe, mss 1912)
O – Chestnut, average curve basis, Sites 1 and 3 (Ashe, "Chestnut in Tennessee" 1912)
□ – Oak, average curve basis, Site 3 (Bulletin 96), "Second-growth Hardwoods in Connecticut," 1912)

with the height-age points obtained from stem analysis, were plotted in a similar manner. The curves drawn to include every plotted point except for a few stations, of which several were on the border line, were strikingly similar to the original chestnut curves.[1] It was necessary to raise the upper limiting curve and to depress the two interior curves slightly, so that the intervals were no longer even, but indicated a greater range of height growth rate of all species for the better sites, a less range for the intermediate, and the least range for the poorer sites. While the wider range in height growth in "Site I" is doubtless due in some measure to the larger number of species found in the coves and moist lower slopes, the absence of any apparent tendency of the different species to group themselves at definite levels in the curve section representing any one site indicates that it is also partly due to an interior variation in site. The cove species—poplar, northern hemlock, cucumber, etc.—were, of course, confined to the "Site I" and the upper part of the "Site II" sections of the curves, while chestnut oak points were most numerous in the lowest section.

Of the stations representing the southern upland hardwoods (oak-chestnut-poplar), 82 fell unmistakably within the limits of one or the other of the three "sites" designated, 6 were "borderland" (the points falling on both sides but close to one of the interior curves), and 8 were "problems," showing inconsistencies as between the heights of "mature" and immature trees, or as between trees of different species. Of the 82 definitely classified stations those falling in Site I included 19 "coves," 3 "lower slopes," and 5 "slopes." In Site II were one "cove," 1 "lower slope," 8 "slope," 1 "upper slope," 1 "swamp," and 4 "ridge" stations, while 11 "slope," 3 "upper slope," 5 "ridge," and 20 "high altitude" stations were classed as Site III.

The inconsistencies were so few, compared with the relatively large number of stations which fully supported the site classification, that they were not regarded as embodying any serious objection to the method proposed. One or two cases are worth noting, since they point to apparent limitations of this method, or at least to precautions which must be taken in its use. One station, for example, contained "mature" hardwoods, largely chestnut oak with a broken canopy of an even height of about 45 feet, indicating "Site III," but with an occasional white pine only 50 or 60 years old but 65 or 70 feet high,

[1] Although the curves are supported by dominants of a large number of species, they apply particularly to chestnut, poplar, oaks of the red oak group, and chestnut oak, which formed the principal basis

indicating "Site II." Under Professor Roth's plan of classification this would probably be taken care of in some such way as "Standard c, Site IV," for chestnut oak, and "Standard b, Site II," for white pine. Rather than introduce a possible element of confusion at this stage in the game, however, it was considered best to cast out white (and other species of) pine as hardwood site indicators, leaving the determination of sites in terms of pine for a later date. Another somewhat similar case involved shortleaf pine and hardwoods. In another case very old chestnut exhibited a height considerably in excess of what could be expected from young trees in the vicinity. The slow growth of the young timber was here attributed to deterioration of the site (which had been repeatedly burned over), rather than to the remote possibility of the older trees having been favored by pockets of deep soil.

Another plot, at the top of Looking Glass Rock on the Pisgah National Forest, showed a mature height of 45 feet, while 22 year-old second growth sprouts and seedlings had already reached heights of from 31 to 38 feet. A possible explanation of this rapid early growth (approximating that in the coves) lies in the amount of soil, which, though limited, was sufficient to supply moisture for rapid early growth up to a certain point, and in the protection from wind afforded by the crowns of old-growth trees near by.

In considering the method of applying the site classification it was felt that the retention of the uneven spacing between the curves was unnecessary, since the determination would usually be based upon averaged heights for one or more ages, and not likely upon a range of heights of any such width as that shown by the curves. The spacing was therefore evened, and the sites were increased from three to six by evenly-spaced interior curves. To conform to an excellent suggestion of Professor Roth that an even unit of 10 feet, or a multiple, at 100 years be adopted as a standard interval in all age-height site classification, these curves were drawn through points 20 feet apart at 100 years, the lowest being 30 and the highest 150 feet. The sites thus indicated were designated Ia, Ib, IIa, IIb, IIIa, and IIIb, so that they may be used for either a three or a six class differentiation, depending upon the degree of refinement required. The curves are shown in the accompanying diagram together with part of the individual dominant tree basis supporting the upper and lower curves. The average height growth of yellow poplar, chestnut, and oak, read from tables made in previous studies, is also shown by symbols. It should be noted that

in the latter studies the age-height tables are based more on young than on old trees; with more data for old trees they would probably conform even better to the site class curves here presented:

The limits for each site class are given by decades in Table 1:

TABLE 1.—*Site class limits (age-height) for southern upland hardwoods, with even 20-foot intervals at 100 years.*

Age.	Height in feet, by site classes						
	Site I.		Site II.		Site III.		
	a	b	a	b	a	b	
Years.	max.	min. max.	min. max.	min. max.	min. max.	min. max.	min.
10	47	40	34	26	20	13	7
20	74	64	54	44	34	23	13
30	90	78	66	54	42	30	17
40	103	89	76	62	48	35	21
50	114	99	84	69	54	39	24
60	124	108	91	75	59	42	26
70	132	115	98	80	63	45	28
80	139	121	102	84	66	47	29
90	145	126	107	88	68	49	29
100	150	130	110	90	70	50	30
110	154	133	113	92	71	51	30
120	157	136	115	94	72	51	30
130	160	138	117	95	73	52	30
140	162	140	118	96	74	52	30
150	163	141	119	97	74	52	30

The curves and the table read from them are not in terms of any one species, but of all the indicator species measured. While it is evident that the classification does not allow for the specific differences in growth rate, this is not as serious an objection as might be supposed. Among the interesting points brought out by the curving was the comparative similarity in height growth of the indicator species; the difference in height between dominant poplars, black oaks, and chestnuts in an even-aged cove stand, for example, or between chestnuts and chestnut oaks in a ridge stand, is relatively small, and is not great enough nor consistent enough to raise, lower, or change the direction of the curves appreciably. Perhaps this is due simply to the relatively wide range in height for a given age allowed for each site; in the six-class series the differences between maximum and minimum height at 50 years is 15 feet, while for the three-class

series it is 30 feet. In mixed even-aged stands it was found that the range in height of the dominants was never as much as that between maximum and minimum for the same age and site in the three-class table, and rarely more than that indicated in the six-class table. The determination of site by means of these tables should, however, be based upon averages between the different species of intolerant hardwoods available for measurement. This will not be hard to do. One hundred per cent pure stands monopolizing any area of uniform site quality large enough to demand separate notice in management plans will never be found, and a mixture of species among the dominants from which an average can be secured will undoubtedly be available in every case.

This classification therefore conforms to the Roth plan of 10-foot unit height intervals at 100 years. In addition the curves set a single "standard" for the less tolerant species ("similar growers") by which, since these are abundant species, the southern upland hardwoods in general may for the time being be classified. Later on the species which differ from these in the direction of the dominant height growth curves may be similarly provided for by one or more sets of "standard" curves, drawn through 10-foot units at 100 years, and thus become a part of a general classification scheme for the species throughout its range. A basis for comparing sites and growth rates for different species or the same species in different parts of the country will thus be provided. Yield tables for a given species and site in different regions may not always be identical; if not, means for evaluating those for one region in terms of another will be found, and such comparisons will certainly be of value.

APPLICATION OF THE TABLES IN DETERMINING SITE

The application of these tables to the determination of site differs somewhat according to the nature of the stand. If the stand is even-aged it is simply a matter of ascertaining its age and the average height of the dominant hardwood trees of a number of species. This can be determined with sufficient accuracy by hypsometer measurements of a very few representative trees. If, as is much more likely to be the case in the Southern Appalachians, the stand is open, uneven-aged, and irregular as to crown height, the determination requires more care. First, some of the "mature" trees, which from their height and crown shape bear evidence of having held a commanding position in the original crown cover, should be measured for total height; their ages

need not be determined if their diameters make it certain that they have reached an age at which height growth is no longer active. Height growth "maturity" is likely to have been reached in trees older than 150 years, so that the heights opposite this age in the table may be regarded as applying to timber mature as to height growth. The heights of the "mature" trees measured should be averaged, and the site found by comparison with the average. This determination should then be checked by measuring the age and height of the dominant second growth of intolerant, rapid-growing hardwoods of the different species which are to be found in the immediate vicinity. Scarlet, red, and black oaks, poplar, and chestnut are suitable species for this purpose. The immature trees chosen for measurement should give evidence of having always been dominant; experience in this study has shown that such trees can usually be found.

Discrepancies between the sites indicated by immature and "mature" trees are to be looked for, especially when the six-class system is used. It should be remembered that the juvenile stage is not always a reliable index, as evidenced by the cases previously cited, and it should be checked by measurements of "mature" dominants, where these can be found on the site in question. As a rule, however, even the younger dominants, when the heights for a given age class are averaged, afford a satisfactory key to the site *as it has been during their life periods*. They do not, of course, tell what the site may become as a result of long continued protection from fire, and yield forecasts based upon them ought to be conservative for sites which have been badly burned.

While the use of isolated trees as indices of site is still questionable pending further study, it is not believed to involve a large risk. In the case of old-growth timber, trees now isolated probably reached their age of height growth "maturity" while still closely surrounded by other trees, since logging operations in this region rarely date back over three decades. The average height of such trees is without doubt close enough to the average height of the upper crown cover of the original forest to serve as a sufficiently reliable index. The second growth measured in such stands, however, must not only not be advance growth, which may have been suppressed at the start, but should be selected, if possible, from groups representing substantially well stocked conditions. It is believed, however, that a comparison of the height growth of dominant second-growth hardwoods of intolerant species in relatively open as compared with closed stands will not show a very great dif-

ference, although the difference in diameter growth may, of course, be large.

The site classification system here described has been criticized as "mathematical" and "artificial," as compared with a type classification upon a biological basis. From a practical standpoint this criticism is believed unimportant. The basing of site determination upon whatever of the upland hardwoods are dominant on an area is justified in the interests of simplicity, ease of application, and relative reliability. It represents the site in terms not of a single but a number of species. It gives a true measure of the site as gauged by an average of the height growth of several species. Different species on the same site will, of course, behave differently in height growth; but until a great deal more has been learned of the similarity of types in different regions and their natural division into "sites within types," the present scheme will furnish an immediate and simple means of classification upon which growth forecasts may be made with greater assurance than without such classification.

USE OF THE SITE CLASSIFICATION IN FORECASTING GROWTH

This involves two general steps: first, the determination of the site, as already described, and second, the application of the available growth data classified by sites. Growth data will be of two kinds, for even-aged, well-stocked stands, and for stands varying in density, age and condition.

Growth of Regular Stands.—For stands of the first sort, yield tables and increment tables derived therefrom will be used. In the construction of yield tables for immediate use advantage was taken of a series of plot measurements compiled by W. D. Sterrett in connection with a study of oak but containing also a large number of measurements of stands running heavily to chestnut, poplar, and other species. Of these plots, 315 were measured in Maryland, mostly on "coaled" lands, by F. W. Besley in co-operation with the U. S. Forest Service, while 25 were made by the writer in the course of the present and previous studies in the Southern Appalachians. The plots were first classified in terms of the general site classification by comparing dominant heights[5] according to age with the curves in the diagram. The cubic yields per acre of the plots thus classified were then plotted and curved.

[5] Codominant heights were used when no measurements of dominant trees were given. This was checked by comparison of codominant and dominant heights when both were given. The difference was rarely found great enough to influence the classification.

These curves were found to be supported by 85 per cent of the plots when the three class series was used and by 68 per cent for the six-class series.[6] In most cases the plots excluded showed low cubic yields, and were regarded as under-stocked. There were very few cases in which the yield indicated a higher site class than that indicated by the rate of height growth. While these exclusions were to some extent arbitrary, they were thought justified in view of the relatively heavy per cent of plots supporting the curves. The plots represent eight composition classes, based upon the proportion by cubic volume of the predominant species; chestnut under 50 per cent (50 plots), chestnut 50 per cent and over (87), chestnut oak (62), white oak (51), black oak (45), scarlet oak (53), red oak (11), yellow poplar (8), and miscellaneous (3). There was no important difference as between these classes in regard to the proportion of plats excluded. For the white and scarlet oak classes, 39 plots, or 37.5 per cent of the total fell too low in cubic yield to coincide in site class as determined for both volume and height, according to the six class series.[7]

Growth of Irregular Stands.—General yield tables for uneven-aged and understocked stands are, of course, out of the question. A number of methods for determining the yields of irregular stands have been suggested,[8] but so far they have not proved successful. The working

[6] It is interesting to note that the proportion supporting the table is considerably greater than in the case of the yield tables for second-growth hardwoods in Connecticut (Forest Service Bulletin 96) in which all plots deviating by more than 10 per cent above or below the average basal area curve for a given site were excluded.

[7] The possibility of using these tables for southern upland hardwoods outside of the Southern Appalachian region was suggested, and the chestnut and oak plots used for the Connecticut yield tables (Bulletin 96) were accordingly classified by height on the site-class curves, and their cubic volumes plotted on the yield curves just described. Only 55 per cent of the plots showed a site coincidence by both height and cubic yield, most of those which failed to coincide falling low in volume. It is quite likely that the use of chestnut alone as a site determinant in the Connecticut study is responsible for the failure of many of the plots to measure up in yield. If an average between the dominant heights of several species had been taken, more of the plots might have been found to fall into lower site classes, consistent with their cubic yields. Difference in rate of growth between Connecticut and Maryland may of course be attributed to climate, but it is also possible that a further comparison of the northern and southern plots, especially on the basis of total basal area or of number of trees per acre and their average diameter, would show that the discrepancy is due not so much to climate as to differences in the field technique, in such directions as the basis used in deciding whether plots were or were not fully stocked. It remains that a large proportion of the Connecticut plots do fall in with the Southern Appalachian site classification as to both height and volume growth, and comparisons are thereby facilitated.

of methods for determining the yields of irregular stands have been

[8] See, for example, Proc. Soc. Amer. Foresters, Vol. 9, No. 2, April, 1914; articles by Chapman, Ashe, Woolsey, and Moore.

out of the site classification has suggested two methods for forecasting the yields of irregular stands. One is simply the use of the yield tables for regular stands, which would give about the maximum yield of a well-stocked area; allowance for cull, understocking, etc., could be made by means of an estimated reducing factor,[9] and it is probable that rather close forecasts could be made in this way. The other method is by means of individual tree growth tables on d.b.h. basis classified according to the sites previously described and arranged for easy use in the field in the preparation of local yield and increment tables suitable for forecasting the growth of the dominant trees under the conditions locally prevailing in an understocked stand.

The plan proposed for the construction and application of the individual tree tables is briefly as follows: Tables are prepared for each species and for each site showing for 2-inch d.b.h. classes, the future d.b.h. at end of 10, 20, etc., years (up to 50 years) of trees now dominant and which may be expected to remain dominant during the period for which the forecast is to be made. Similar tables are made showing the present volume in cubic and board feet and that at the end of 10, 20, etc., years (up to 50 years) of trees corresponding in d.b.h. to those in the tables just described, and in height to the figures in the height growth site classification. The field man who wishes to apply these tables in forecasting the growth of an understocked stand first determines the site of the area according to the height growth table. He then lays out and tallies one or more sample plots representative of the local conditions of stocking, mixture, etc. This tally is by 2-inch d.b.h. classes, by species, and by crown classes. Having the number of dominants of a given species and d.b.h. class, the present volume and probable future volume of these trees at the end of any decade can be quickly determined from the volume forecast table by a simple multiplication. When this is completed for all the d.b.h. classes and all the species the results are added and placed on an acre basis. The figures thus obtained give the total present and probable future yields per acre of the dominant trees on the area, and furnish a means by which the future rate of growth, may be readily estimated. The intermediate and subordinate crown classes are ignored in this growth forecast, since their growth is small and many of the trees will likely disappear from the stand before long. Their volumes

[9] Or the plan suggested by Ashe ("Determination of Stocking in Uneven-aged Stands," referred to in footnote 8) may provide a means for applying "normal" yield tables to irregular stands.

are therefore computed from the tables for the present time only. Since the volumes at the present time, given in the tables, are for dominant trees they will overrun somewhat the volumes of intermediate and, especially, subordinate trees, but this is believed unimportant as the aggregate volume of these trees will be relatively small. After eliminating the smaller trees which may be expected to die or be removed before the end of the forecast period, the volume of the remainder may be considered the same at the end of the period as at present, or a slight increment may be added.

It is not believed that forecasts on the above basis can be made with any assurance for more than four or five decades, since the ability of trees now dominant to remain for any long period even in a stand at present fairly open, can only be guessed at. Two things are certain: the shorter the period the more accurate the forecast; and the younger the stand the more nearly it will approach even-aged conditions and the more closely will correspond the yields in the tables for even-aged stands. Forecasts thus made ought to be checked by what is known regarding the basal area, size, and number of trees per acre in mature dense stands for the site under considerations. This method of growth forecast is, of course, very approximate. Like the site classification, it is proposed as a means of getting something at once which we could hardly hope to obtain otherwise for a long time. As rapidly as data become available whereby more accurate and refined results are assured, the growth forecast methods here described may be laid on the shelf.

AMERICAN STORAX PRODUCTION: RESULTS OF DIFFERENT METHODS OF TAPPING RED GUM TREES

By Eloise Gerry

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During the recent war the supply of Oriental storax obtained from *Liquidambar orientalis* Mill. was cut off, and interest was aroused in the commercial production of our native sweet gum, or American storax, from *Liquidambar styraciflua* L., the red gum or star-leaved gum. During 1918 the Forest Products Laboratory was active in bringing together producers and consumers, with the result that several thousand pounds of gum were marketed. Because of war conditions this storax brought an abnormally high price.

USES OF STORAX

Storax is used in the manufacture of pharmaceuticals, perfumes, and tobacco. It is also a source of cinnamic acid and cinnamyl alcohol, which, in turn, are used in making perfumes, pharmaceutical preparations, and fine chemicals. Before the war about 35,000 pounds [1] of storax was imported for annual consumption.

CHEMICAL ANALYSES

Analyses made at the Forest Products Laboratory [2] and elsewhere [3] have been published, and indicate that the American storax compares well with the Oriental storax and should prove equally satisfactory for commercial purposes. Reports on the commercial use of the domestic product have also been favorable.

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[1] Reports Bureau of Statistics, U. S. Dept. Commerce and Labor.

[2] Mahood, S. A. in. ed.

U. S. Dispensatory XX. 1077.

Tschirch: "Die Harz und die Hartzbehalter" 1906, 308.

Dieterich: "Analysis of Resins, Balsams and Gum Resin (1901) 233.

Delphin: "Chemical Abstracts" 2 (1908) 2845.

Delphin: "Apotheker-Zeitung" 23 (1908) 79.

Van Itallie: "Chemisches Central-Blatt" (1901) 856.

Jordan: Journal Industrial and Engineering Chemistry 9 (1917) 770.

THE EXPERIMENTS IN TAPPING

The American methods of collecting storax are not standardized. Field experiments to determine production costs and methods that would permit the domestic product to compete with the imported material were planned and conducted by Dr. S. A. Mahood, chemist at the Forest Products Laboratory, in cooperation with Mr. B. E. Needham, of Lottie, Louisiana. Trees growing on land owned by Mr. Needham, north of Elliott City, Louisiana, were used in the work. The land was low, more or less swampy, and subject to occasional overflow. The timber formed a rather heavy stand of second growth material, consisting chiefly of red gum varying from 10 inches to 2½ feet in size, and of ash and water oak with an undergrowth of blackberry brier. Although attempts had been made to obtain storax by extracting red gum bark, leaves, and twigs, and mill waste with solvents, negative results had been obtained owing to the fact that the storax of commerce is a pathological product formed in the living sapwood of the tree as a response to injuries or wounds.

Three methods of obtaining the gum were compared in this experiment. Fifty trees were used. Ten trees were "deadened" or girdled by removing a strip of bark several inches wide from the entire circumference of the tree. Twenty trees were tapped by cutting four perpendicular streaks 3 feet in length on each with a turpentine hack. The scars were about one-half inch in width and extended into the sapwood. Twenty trees were tapped by making several approximately horizontal streaks 4 inches apart, so that the total length of the exposed surface was the same as in the perpendicular scars. Half of the horizontal taps had a north and half a south exposure, and the vertical taps were placed approximately at the four points of the compass, but little or no effect was noted as a result.

The trees were tapped on May 30, 1919, and gum was collected [4] on June 10 and 21, July 10, August 2 and 15, September 10, October 4, and November 14.

THE YIELDS OF STORAX OBTAINED [5]

The exuded gum was collected by scraping the surfaces of the taps with a blunt case knife. This was the only means used to freshen the surfaces of the wounds. It was thought that in future, with more

care in collection and more frequent gatherings, somewhat higher yields might be secured. The samples of gum furnished contained considerable trash, which was removed by filtering. The absorbed gum was dissolved from the filtered trash by extraction with 95 per cent alcohol, which was then evaporated. The amount of storax obtained from each group of trees tapped by the same method is given in Table 1.

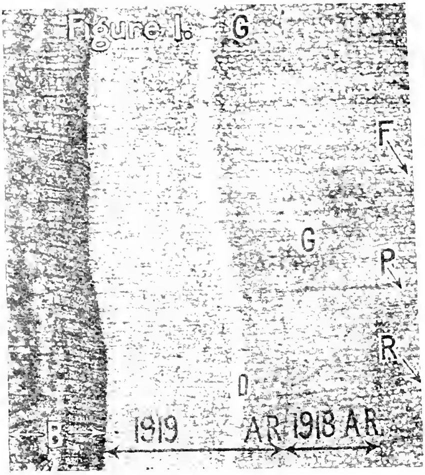
[4] Mahood, S. A., and Eloise Gerry, in. ed.

[5] See Mahood, S. A., and Eloise Gerry, in. ed.

TABLE 1.—*Amount of storax obtained by different methods of tapping.*

	Perpendicular taps, 20 trees	Horizontal taps, 20 trees	"Deadened," 10 trees
	Grams	Grams	Grams
Storax, filtered	651.0	1134.3	371.5
Storax, extracted with alcohol	158.5	322.5	57.0
Total storax	809.5	1456.8	428.5
Av. per tree	40.5 (1.4 oz.)	72.8 (2.5 oz.)	42.8 (1.5 oz.)

The largest yield of storax was obtained by the horizontal tapping of the trees, and was secured during hot August weather. The cost per pound of storax collected in the experiment was $2.37, which promised only a small profit. During the war the wholesalers sold storax to the trade at $4 a pound. Considering the fact that the men engaged on the experiment were inexperienced, and that the results from the methods producing the lower yields were included in determining the cost figures per pound, it is estimated that the commercial production price can be reduced at least 50 per cent.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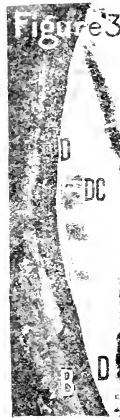
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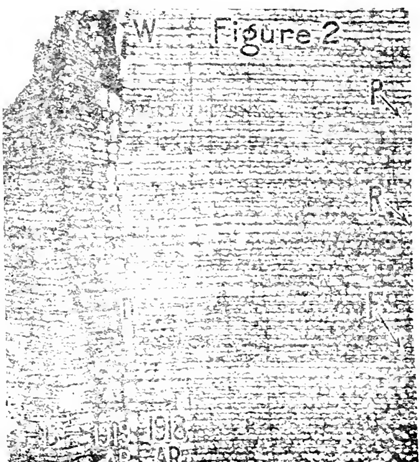
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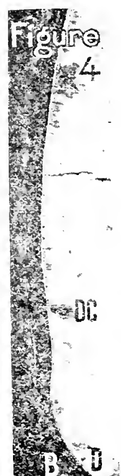
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THE STRUCTURE OF THE STORAX-PRODUCING WOOD

(Legends for illustrations on page 18)

Fig. 1—Cross section of wood above girdle. 1918, normal wood; 1919, wood formed after girdling, one row of ducts.

Fig. 2—Cross section of wood near vertical cut; 1919, wood formed after wounding, more than one row of ducts.

Fig. 3—Cross section above top horizontal cut. Note abundant ducts. (Small dark spots near the bark) and well developed growth ring.

Fig. 4—Cross section below lowest horizontal cut. Note near bottom of picture relatively few ducts and narrow growth ring. Upper portion under uncut bark at side of wound shows more ducts and wood.

D, ducts; AR, one year's growth (annual ring); R, ray; P, pore; F, fiber; B, bark; W, wound beginning to heal over; G, gummy deposit; DC, discoloration.

RESULTS OF MICROSCOPIC STUDY

The specimens selected by Dr. Mahood for microscopic study were from typical trees and represented examples of the effects produced by the different types of tapping. They were collected in December, 1919, and turned over, in the green condition, to the writer. Although this material was limited in amount, the results from studying it agreed with the average yields of the field tests. Furthermore, they suggested possible improvements in figure operations for storax production.

Red gum has the typical diffuse-porous type of structure, as shown at "1918 A. R." (figs. 1 and 2). In the wood formed after tapping, abnormal structures from which storax exudes ("D," figs. 1-4) were produced near the wound. These are similar to the induced vertical resin ducts found in turpentined pines.[6] They are not enlarged vessels but intercellular spaces. No horizontal gum ducts were formed. Other structural changes (figs. 1 and 2) were also to be noted in the wood formed after wounding, namely:

1. The pores tended to become smaller. In the horizontally tapped specimen pores were much fewer than in normal specimens; in the girdled and vertically tapped specimens they were rather more numerous than usual.

2. The rays appear larger. They may be merely distended, or several may have fused together, or they may actually have added more cells in width. This was particularly noticeable above the girdle in the "deadened" tree.

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[6] Svendsen, J.I.B., "Ueber den Harzfluss bei den Dicotylen," 1905.

3. The small cells (fibers, etc.) scattered between the pores had thinner walls.

4. Dark colored gummy material was apparent (especially near the wound), notably in the rays, often in the fiber cavities, and sometimes even in the vessels.

5. Much starch was seen in all the specimens.

CHARACTERISTICS OF THE GUM DUCTS

From the material available (collected in December) it was impossible to determine the manner in which the ducts originated and developed. At the end of the season they appeared on the end grain of the wood as openings of various sizes. The ducts first formed were generally largest, being widest in the radial direction and oval in contour. They usually occupied all the available space between rays. The ducts formed later or at a considerable distance from the wound tended to be smaller and more rounded in form.

In the girdled tree specimen a single continuous row of ducts above the girdle and a very considerable amount of wood was formed (fig. 1). In the other two specimens more than one row of ducts which varied in size was formed. Some of these ducts exceeded in size the largest in the girdled specimen and others were very small. The size and number of ducts decreased as the distance from the wound increased. Fragments of cells, chiefly from the tangential sides of duct, often extended into the canal cavity. The canals, when examined in longitudinal sections, were frequently somewhat constricted.

THE DISTRIBUTION OF THE DUCTS

The girdled specimen showed one uniform row of rather large ducts (fig. 1). The vigorous growth apparent above the girdle was probably made possible by the damming up at this point of the nutritive material carried down the tree from the still living and functioning foliage and from the supply of stored materials formed in the sapwood before the girdling.

In the vertically tapped specimen the rows of ducts extended away on either side of the wound for a distance of about three-quarters to 1 inch, where they were gradually reduced and ceased to form. On one side a double row of large ducts was very conspicuous, and a partial third just forming was visible (fig. 2). On the other side only one row similar to that on the girdled tree was noted.

The effect produced by the horizontal tapping was similar to but more extended than that of the vertical scarifying. The distribution of the ducts near the scars on the horizontally tapped tree was considerably different in the wood above the uppermost wound from that near the lower cuts. Ducts were largest and most numerous and the wood formation greatest near the top, where the supply of materials from above was most abundant. The end of a lower scar and some of the bark beyond it was present on the specimen examined. It was noted that under the unscarred bark below and beyond the cut more wood was formed, but not more ducts than at the scar itself. The duct formation ceased in this case about 2 inches beyond the end of the scar. About two rows of ducts were present on the average below a lower scar; three or four often appeared above the upper scar, although they frequently were discontinuous in this region. In general, less ducts and wood were formed below the scar than above it (see figs. 3 and 4). Ducts extended more than 2 inches above an upper horizontal scar.

From the material available it was impossible to determine the full vertical extent of the ducts above and below the various wounds.

The highest yield of gum was obtained from the horizontally tapped trees; that is, under this method of operation there was a direct relation between the development of the greater number of gum ducts and the yield secured.

A marked browning of the sapwood back of the scars occurred, and sometimes extended vertically for some distance in the wood. Some spores and fungous mycelium were found in the wood.

It was also noted that bees were attracted by the exuding storax, and that borers infested some of the tapped trees.

CONCLUSIONS AND SUGGESTIONS

The material studied microscopically was too limited to permit the drawing of positive conclusions, but the microscopic study results agreed with those derived from the field experiments. Further field erperiments and special collection *in the field* of suitable material upon which to conduct further investigations are essential to obtain a comprehensive understanding of the practical possibilities of this industry. It seems probable that encouraging storax gathering on an extended scale would result in materially increasing the value of red gum stumpage, and also in utilizing many of the poorer trees now considered as practically worthless for lumber. Scarifying to induce storax produc-

tion could well be carried on for several years in advance of the cutting of the larger and more valuable stands of timber.

Judging from the specimens studied, the "deadening" or girdling of the tree is relatively unprofitable as a means of inducing gum production, since the gum and gum ducts do not form in sufficient abundance to produce a high yield. Furthermore, continuance of this method for much more than one year is prevented by the death of the tree.

The vertical method of chipping also gave a low yield. But the fact that the narrow (one-half-inch) scars heal quickly might be advantageous from a lumbering standpoint. Under present methods of operation a small part of the wood immediately behind the scars, usually becomes discolored (compare figs. 3 and 4 "DC"). In young timber this defect as well as the irregularly arranged wood cells would probably be noticeable later when the wood was cut up. Finally, although growth of the tree may be little retarded, fewer ducts and consequently less storax was produced as the result of this type of cutting than from the horizontal method. It is possible that chipping with a French hack and broadening the scar from time to time (perhaps twice a year) might increase production by the vertical scar method.

Almost double the amount of gum was obtained from the horizontal method of scarifying than from either of the other methods discussed. This method stimulated the formation of more wood and more gum ducts, and promised a means of easily obtaining sustained yields through freshening the chipping once or more each year by removing a one-fourth to one-half inch chip as is done weekly in turpentining pines, where the production of gum is characteristically more abundant.

Streaks should not be cut directly above each other or at least the number so placed should be reduced and they should not be so close together. Groups of streaks might be staggered or otherwise arranged around the tree, leaving between the streaks sufficient continuous portions of uncut bark (in total approximately one-third of the circumference) to insure free sap movement both upward and downward in contrast to the complete cutting off of the downward stream which occurs in the case of girdling. Cups hung to catch the exuding gum would probably be advantageous, especially in the hottest weather.

The Length of the Ducts.—No material from any of the methods was available on which the total vertical length of the ducts, either above or below the cuts, could be determined. They extended more

than 2 inches above the scar in at least one horizontally tapped specimen. One case of the vertical extent of the effect of a wound stimulus in pine has been observed by the writer where the structure more than 6 feet above the wound was modified.

The Depth of the Streak or Scarification.—The cut should probably be only deep enough to expose completely the surface of the last formed wood since all the ducts are produced in the new wood which grows after the cut is made. There appears to be no advantage (unless it intensifies the stimulus) to be gained from cutting deeply into the wood when scarifying gum trees.

The proportion of the circumference to be cut to give the best yield would have to be determined by experiment. It is suggested, however, that about one-third of the circumference should be covered with the uncut bark. Clean cutting with sharp tools should be required.

Checking the Entrance of Decay Through the Exposed Wood.—It would be very desirable to make experiments to reduce, if possible, the attack by fungi or bacteria and the discoloring of the wood near the scarifications by perhaps painting them with some substance that would be toxic to or prevent the entrance of organisms and would at the same time not be water soluble or volatile or sufficiently poisonous in character to injure the gum for any of the purposes for which it is used. It is possible that a quick drying rosin mixture or some other coating might be devised for the purpose. This would also prevent the often harmful drying out of the sapwood, which takes place through the exposed surfaces. It would be desirable to apply the coating when the first cut is made so that it would in no way clog the ducts forming later in the new wood above the scar.

The Position of the Scarification.—The best yields of oleoresin may possibly come from the early low chipping at the butts of pine trees. Therefore, it is a point worthy of consideration to determine where the optimum position as regards both yields and ease of working is to be found.

When to Scarify the Trees.—Although there are no data on this subject for red gum, results from experiments on wounding pines to induce excessive flow of oleoresin, might at least be indicative. It has been found in the case of longleaf pine that there is a distinct advantage to be gained in quantity of yield and in securing an early flow of gum as the temperature rises in the spring, by placing what is known as the "advance streak" on the timber. This consists in chipping or

scarifying the trees early in the season (January, February, or early March) before wood formation for the year has begun. In this way the tree is apparently stimulated so that, when wood formation actually begins, resin yielding tissue is formed early. In pines an increased yield from the resiniferous tissue normally present before chipping is also obtained.

In red gum there are no gum ducts present in the normal unchipped wood but by chipping early in the season it might be possible to induce an earlier formation of ducts and an earlier yield of gum than would result if the scar was cut just at the time when the weather was warming up and wood formation had already begun. In the material studied which was chipped May 30, 1919, wood formation had apparently begun to some extent at least. (Note wood formed before the ducts, figs. 1 and 2.) There seems to be a practical confirmation of the advisability of this early scarification in the fact that in this experiment from 4 to 6 weeks elapsed before any considerable yield of gum was obtained from the scarified trees. The response to the wound stimulus was slow and until the ducts could be formed no appreciable yield could be expected. A study of material collected through the growing period would show how much time is required for duct formation. Inclement weather would unquestionably retard gum flow and also wood and gum duct formation so that this alone might be a very significant factor. All things considered, however, cutting the wounds on the gum trees early, say in February or March, would be an experiment well worth trying.

HIGH TEMPERATURES AND EUCALYPTS

By E. N. Munns

Forest Examiner, U. S. Forest Service

The month of June in 1917 was one of the warmest and driest ever experienced in southern California, although up to that time the year had been cooler than normal. During the winter and spring months certain pressure conditions in the northwest usually cause the frequent and severe windstorms known as "northers" or "Santa Anas." These conditions prevailed in 1917 from the tenth to the twentieth of June. At different stations in southern California the mean temperatures averaged three to four degrees above the monthly mean; the maximums were ten to fifteen degrees above the normal and ranged from 100 to 121 degrees F. Differing from most of the "northers," the wind movement during this period was slight, not exceeding 15 miles an hour. Even this caused great discomfort, for the air was like a draught from a hot oven. It took away the breath and scorched the flesh. The shade was almost as unbearable as the sun. Heat prostrations are almost unknown in southern California, but several were recorded during this period.

Temperatures above 100 degrees are not uncommon in the valleys of southern California during the months of July, August, and September, but the effect of the temperatures is usually mitigated by cool, refreshing nights. During this June wave, however, the minimum temperatures were several degrees above the normal. On this account the heat was noticed much more than it would have been under ordinary conditions. The temperatures recorded at different places in the valleys of southern California are given in Tables 1 and 2, the data being taken from published reports of the United States Weather Bureau.

As none of the co-operative stations of the Weather Bureau are equipped for recording humidity and evaporation, the data taken at the Converse Experiment Station during this period are of interest. Table 3 gives in cubic centimeters the daily evaporation and the relative humidity taken from a sling psychrometer at 6 p. m. daily from the porous-clay cup atmometers

TABLE 1.—*Maximum temperatures at selected stations in southern California.*

[Daily maximum temperatures—Degrees F.]

Stations.	June, 1917.									
	12	13	14	15	16	17	18	19	20	21
Calexico	101	108	113	113	117	115	115	111	107	108
Indio	103	110	115	112	120	120	117	112	109	110
Escondido	87	93	108	105	104	108	100	94	84	86
Los Angeles...	79	80	100	99	97	105	85	84	78	77
Pomona	93	99	110	112	115	117	100	97	93	92
Redlands	92	102	108	111	113	114	103	101	94	95
San Jacinto...	92	111	111	113	115	115	113	110	102	106
San Barnardino	95	105	110	112	114	116	105	102	96	98

TABLE 2.—*Mean temperatures by periods at selected stations during June, 1917.*

Stations.		June periods, 1917.		
		1-11	12-21	22-30
Calexico	Max.	98.5	110.8	105.5
	Min.	61.5	70.5	61.3
	Mean	80.0	90.7	83.4
Indio	Max.	98.5	112.8	106.8
	Min.	66.4	75.4	73.9
	Mean	82.4	94.1	90.3
Escondido	Max.	82.6	96.9	88.1
	Min.	53.0	54.6	50.1
	Mean	67.8	75.7	69.1
Los Angeles.........	Max.	69.5	88.4	80.0
	Min.	52.5	62.4	60.9
	Mean	61.0	75.4	70.4
Pomona	Max.	81.4	102.8	92.5
	Min.	46.4	52.7	49.9
	Mean	63.9	77.7	71.2
Redlands	Max.	82.3	103.3	94.0
	Min.	49.4	61.0	55.5
	Mean	65.8	82.1	74.7
San Jacinto	Max.	89.9	108.8	100.8
	Min.	46.8	58.2	53.5
	Mean	68.3	83.5	77.1
San Bernardino......	Max.	84.2	105.3	96.0
	Min.	47.0	57.2	52.6
	Mean	65.6	81.3	74.3

TABLE 3.—*Evaporation data—Converse Experiment Station (6000 feet elevation in the San Bernardino Mountains.)*

Date. June, 1917.	Evaporation from atmometers.	Relative humidity at 6 p. m.
	Cc.	Per cent.
6	20.3	70
7	24.3	63
8	29.5	65
9	24.0	71
10	27.3	62
11	28.0	31
12	34.0	20
13	39.0	28
14	41.3	
15	41.0	11
16	42.5	20
17	40.0	24
18	36.0	36
19	37.0	32
20	33.0	52
21	32.0	48
22	28.0	53
23	29.0	62
24	27.0	63
25	28.0	57

The effect of these trying conditions upon all plant life was very noticeable; buds, young fruit, small fruits, and a large proportion of the vegetable crop were more or less injured. The loss, however, was confined to the season's crops; except in the case of annuals, the heat did not permanently injure mature plants. The heavy application of water to some of the fields prevented a total loss, but the transpiration systems of the plants were unable to meet the large demand suddenly made upon them.

This drought affected the eucalypts as noticeably as it did the orchards and agricultural crops. The foliage of many eucalypts was entirely killed; this gave them the appearance of having experienced a fire. Other trees were only partially "burned," while still others in protected situations were uninjured. The heat damage closely resembled the damage done by frost in 1913, but, since it came in the middle of the busy field season, the people did not destroy their trees, and the most severely injured ones were given a chance of recovery.

The effect of the high temperatures upon the trees varied decidedly from place to place. At first this variation was thought to be the

result of differences in the degree of protection from wind or high temperatures. It was finally realized, however, that differences in soil moisture were responsible for the variations in the effect of the drought, and that the soil moisture was, perhaps, more dependent on the depth of water table than on the water-holding capacity of the soil. That the latter condition had an important bearing on the effect of this hot wave was shown in instances in which the water table was at such a depth that the trees could hardly have obtained much moisture from it.

The character of the soil, indicated by the moisture equivalent, influenced the amount of damage to a striking degree. On sandy soils the damage was far greater than any other kind of soil. This was especially noticeable at Fontana. Here the soil is pure sand of great depth, and hundreds of trees, planted for windbreaks about young citrus groves, were killed. There was little difference in the amount or character of injury to trees growing in sand and in clay. However, where the water table lay fairly close to the surface and was, therefore, within easy reach of the root systems, trees on clay soils suffered only slightly if at all. Trees on loamy soils, as a rule, were injured considerably less than trees on any other type of soil, apparently being more or less independent of the depth of the water table. This was strikingly seen near Cucamunga, where a long row of gray gums had been planted. The earth in which these trees grew varies from a sandy soil at the foot of the hill, through a loamy soil at the middle elevations, to a heavy adobe at the upper end. Progressively from the foot of the hill to the top, the trees showed, first, almost complete destruction of foliage; then a heavy though partial defoliation; at the center, very little injury of any kind; then, again, a partial leaf injury; and, finally, at the end of the row in the clay type of soil, complete loss of all leaves and the death of the trees. Near Azusa there were considerable plantings and these showed the effect of this heat wave. Trees in the lower belt of the hills, where the soil is decidedly gravelly, suffered severely from the loss of their foliage, but the trees farther up the hill, where the soil is heavier, were much more free from injury. At the Del Rosa plantations, two species, *Eucalyptus rostrata* and *E. tereticornis*, are planted on a long slope, ranging from a sandy wash to a heavy adobe soil farther up the hill, a distance of about 75 yards. The effect on these trees was similar to the effect on those in the other place. The trees in the sandy wash and those at the top of the hill on the heavy soil lost the major part of their crowns, but those on the loamy soils of the middle elevations lost only a small

Species.	Age	No. of trees, basis	Character of soil	Depth of water table	Condition of soil	Effect of high temperature in per cent.					
						Trees killed	All leaves killed	Partial loss of foliage over 50%	Partial loss of foliage under 50%	Slight loss of foliage	No damage
E. citriodora	20	27	Loamy clay	Very deep	Irrigated				19	26	55
E. corynocaylx	23	1600	Clay loam	75 ft.	Dry-baked	2	1	11	23	35	28
E. corynocalyx	14	1000	Sandy loam	50 ft.	Dry				7	15	78
E. crebra	20	35	Sandy loam	Very deep	Irrigated						100
E. diversicolor	9	400	Sand	Very deep	Very dry	2	2	7	9	38	44
E. diversicolor	7	9	Loam	80 ft.	Dry					11	89
E. globulus	30	700	Sandy loam	60 ft.	Irrigated				7	16	77
E. globulus	25	230	Sandy loam	Unknown	Dry				14	38	48
E. globulus	20	900	Sand	80 ft.	Dry	4	4	17	11	62	6
E. globulus	20	167	Loam	60 ft.	Dry					32	68
E. globulus	15	78	Loam	Unknown	Irrigated					12	88
E. globulus	12	300	Clay loam	Very deep	Dry		18	11	33	52	10
E. globulus	7	570	Sand	Very deep	Irrigated	70	70	27	3		
E. goniocalyx	7	292	Sand	Very deep	Dry				9	36	55
E. polyanthema	18	1100	Sandy loam	Very deep	Dry			6	35	59	
E. polyanthema	15	209	Clay loam	65 ft.	Dry			10	56	34	
E. polyauthema	15	31	Sand	Very deep	Dry		12	62	17	9	
E. polyanthema	2	256	Sand	Very deep	Irrigated	89	89	8	3		
E. rostrata	20	520	Sandy loam	Unknown	Very dry				3	17	80
E. rostrata	12	1800	Sand	Unknown	Very dry				5	45	50
E. rostrata	15	680	Sandy loam	Unknown	Very dry			5		30	65
E. rostrata	10	600	Loam	Unknown	Very dry					5	95
E. rostrata	7	127	Sand	80 ft.	Very dry		7	23	14	17	39
E. rostrata	7	350	Loam	85 ft.	Very dry					35	65
E. rostrata	7	184	Clay	100 ft.	Very dry		4	1	19	28	48
E. rostrata	3	720	Sand	Very deep	Irrigated	61	67	31	2		
E. tereticornis	20	91	Sandy loam	Unknown	Irrigated					3	97
E. tereticornis	20	18	Loam	Unknown	Irrigated					11	89
E. tereticornis	16	55	Clay	70 ft.	Dry			13	26	61	
E. tereticornis	12	120	Sandy loam	Unknown	Dry					85	15
E. tereticornis	7	820	Loam	85 ft.	Very dry					17	83
E. tereticornis	7	78	Sand	80 ft.	Very dry		6	16	13	65	
E. tereticornis	7	49	Clay	95 ft.	Very dry		35	20	41	4	
E. tereticornis	3	612	Sand	Very deep	Irrigated	63	65	19	16		
E. viminalis	20	1200	Sand	60 ft.	Very dry	5	15	15	25	45	
E. viminalis	20	600	Sandy loam	50 ft.	Dry			20	40	40	
E. viminalis	7	315	Sand	Very deep	Very dry				82	18	
E. viminalis	7	37	Sandy loam	80 ft.	Very dry				32	68	
E. viminalis	3	240	Sand	Very deep	Irrigated	60	60	20	15	5	

portion of their foliage. Apparently the influence of the soil is the primary cause of the difference in response to adverse conditions.

The freeze of 1913 acted on the plants at the beginning of the growing season, and the damage was caused either by the destruction of or changes in the cell sap, or by the breaking down of the tissues by the low temperatures. The heat wave of June, 1917, occurred at the close of the spring growing period and acted on the transpirational system, all plants being subjected more or less to the same general conditions. Wherever ground water was available, either on account of irrigation or the closeness of the water table, the plants were able to obtain sufficient water to carry on their normal functions, notwithstanding the greatly increased demands caused by the high temperatures and excessive evaporation. It was necessary, therefore, for the soil to furnish the water to compensate for the loss caused by evaporation. Only those trees escaped injury that grew in soils containing sufficient available water, and the amount of injury was largely a measure of the available water.

The effect of the drought depended not so much upon the species as upon the soils in which they grew, for the species that were injured in one soil type were entirely free from injury when growing in another. A number of the species that are ordinarily listed as drought-resistant were badly injured because of the character of soil in which they were growing, while other species known to require water were not appreciably hurt. Thus, the casual observer was given a wrong impression of the value of the species. Table 4 indicates, for a number of places where plantations were visited, the species, the nature of the soil, and the character of the injury.

The damage to trees growing in loam soil is practically negligible, as Table 5 shows, but the extent of damage to those growing in sand and to those growing in clay soil is nearly the same. The sandy-loam and clay-loam soils in the matter of injury occupy an intermediate stage between these two extremes, trees in the clay loams suffering somewhat more damage than those in the sandy loams. It would be interesting to arrange the following data with respect to depth of water table or moisture content of the soil, but unfortunately too little is known of this factor to make such an attempt practicable. However, it is believed that, irrespective of the depth of the water table, the character of the soil has a decided influence on the amount of injury.

TABLE 5.—*Injury to eucalyptus based on general soil types.*

Soil type	No. of trees, basis	Percentage of trees injured.					
		Trees killed	All leaves killed	Partial loss of foliage			
				Over 50 %	10 to 50%	Under 10%	No damage
Sand	7,288	18	21	16	19	28	16
Sandy loam..	5,116			1	8	30	61
Loam	1,982					18	82
Clay loam....	2,109	1	6	11	37	40	6
Clay	334		13	11	29	31	16

Table 4 has been summarized, and in Table 6 the essential data about the injury to the various species are presented without respect to the nature of the soil.

TABLE 6.—*Injury by species.*

Species	No. of trees, basis	Percentage of trees.					
		Killed	All foliage killed	Part of foliage killed			No injury
				Over 50%	10 to 50%	Under 10%	
E. citriodora...	27				19	26	55
E. corynocalyx	2,600	1	1	5	12	17	65
E. crebra......	35						100
E. diversicolor.	409	1	1	3	5	24	67
E. globulus....	2,885	9	13	7	10	34	36
E. goniocalyx.	292				9	36	55
E. polyanthema	1,699	22	25	22	28	25	
E. rostrata....	4,461	10	10	7	5	21	57
E. terticornis..	2,846	3	3	6	12	31	48
E. viminalis...	2,392	13	15	11	39	35	

The following list, derived from the foregoing table, gives in a general way the relative resistance to exceptionally severe drought of the more important eucalypts in southern California, the more drought resistant heading the list. The species that were represented by less than 500 trees have been omitted.

E. diversicolor · *E. tereticornis* · *E. viminalis*
E. corynocalyx · *E. globulus* · *E. polyanthema.*
E. rostrata

The effect of the high temperatures and low humidity upon the trees was to cause them to wilt rapidly. Trees that were able to obtain water fast enough and in sufficient quantities were uninjured; those that were not quite able to cope with the situation were partially burned; the moisture was removed from all the leaves and twigs of those unable to meet the demands, as the drain was made upon the whole system, no adventitious buds were put out to correct the trouble later.

The trees that died were located in places where they were fully exposed and where the full force of the desiccating wind was felt. These trees were dried to such a degree that, when they were examined a short time later, all parts of the stem appeared to be thoroughly seasoned. The trees whose foliage was the only part entirely killed had some protection from the full force of the wind; and, although a number of the twigs and smaller branches were killed, the rest of the tree was not dried past recovery, and new leaves were soon put out and an occasional adventitious shoot. In the more severe cases of defoliation, the losses were confined almost entirely to the upper part of the crown and the fringe of leaves on the periphery of the crown, though a few twigs and small branches were killed. The recovery from this damage was indicated by the appearance of new leaves on the live stems, though the upper part of the crown produced fewer than did the lower portion of the tree. Occasional adventitious shoots on the larger branches and in the upper part of the crown were formed. Where the injury was slight, it was confined to the killing of entire leaves at the tips of the branches or in the tops of the trees; whereas the cold damaged the tips and edges of the leaves more often than the entire leaf. Recovery took place most quickly on the areas where irrigation was practiced and where the trees could derive the benefit from water applied to the adjoining crops.

GENERAL CONCLUSIONS

The effect upon the trees of being subjected to this period of sudden drought is interesting because of the information it gives about the behavior of the different species. While eucalypts have been planted under many diverse conditions, little has been done to summarize the results of experience, and what species are successful under given circumstances is not generally known.

It appears from the above general observation that eucalypts can better withstand untoward conditions if they are planted in loamy soils

or where the trees are able to reach the permanent ground water or water table. Under these latter circumstances there is, perhaps, no species that is unable to withstand long-continued drought or untoward evaporation conditions; but, if the tree is unable to obtain this supply, water must be specially applied to meet its needs.

Of the species noted, taking into account the conditions to which they were subjected, the age of the trees, and their treatment, two species, *E. rostrata* and *E. tereticornis*, appear to be the best for planting in regions of high temperatures and high evaporation. This is, in general, in harmony with the known character of the trees. These two species make the most rapid growth and present the best form under the severest conditions; they withstand both low and high temperatures better than the other important species do; and they are more adaptable than the others to wide ranges of soil and site conditions. Their behavior in the instances now recorded increases the belief in their usefulness for all kinds of planting, and one is tempted to add, "If in doubt, plant either *E. rostrata* or *E. tereticornis*."

STANDARDIZATION OF LUMBER SIZES AND GRADES

By David G. White

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Numerous and constantly changing lumber grading rules and sizes and the ever increasing demands of the consumers for lumber of satisfactory common standards for their requirements, stimulated the first American Lumber Congress, which was held in Chicago on April 14 to 17, 1919, to adopt the following resolution:

"*Resolved*, That it is the sense of this Lumber Congress that there should be uniformity of sizes in all lumber and moldings manufactured in the United States and that for the accomplishment of this purpose the Secretary-Manager of the National Lumber Manufacturers' Association be requested to call a meeting of the proper representatives of all associations represented in this Congress at Chicago within sixty days from this date."

In compliance with this resolution, about forty representatives of lumber associations, manufacturers, wholesalers, retailers, architects, engineers, and the trade press met in Chicago on June 30. Resolutions were adopted at this conference calling attention to the need for standard sizes, grades, forms, and nomenclature for lumber, moldings, and shingles. A plan for future work was outlined which would solicit the help of manufacturers, wholesalers, retailers, architects, engineers, the Forest Products Laboratory, and others interested.

A second conference was held in Chicago on September 28 and 29, 1920. This conference was widely heralded by the press and was well attended by representatives of the associations and organizations previously mentioned. September 28 was given over to a discussion of sizes of common board and strips, dimension, finish, flooring, ceiling, partition, grooved roofing, fencing, drop siding D. & M., drop siding, worked shiplap and rustic, shiplap, and bevel siding. The scheme of sizes recommended is as follows:

One-inch rough 15/16-inch.

One-inch S1S 7/8-inch.

One-inch S2S 13/16-inch.

One and one-half-inch and under (to 1-inch), for both width and thickness, take off 3/16-inch S1S1E or S2S2E.

Two-inch to 6-inch inclusive, for both width and thickness, take off 3/8-inch S1S1E or S2S2E.

Over 6-inch, for both width and thickness, take off ½-inch S1S1E or S2S2E.

Rough sizes were not stated for any stock except 1-inch, but are, nevertheless, supposed to be of sufficient size when seasoned to a maximum of 20 per cent moisture to surface to the actual sizes recommended by the association for the stock in question. With but minor changes the conference referred the sizes back to the manufacturers with the request that they be officially adopted and put into practice at once.

September 29 was devoted to patterns and sizes of moldings. The types of moldings were based largely on the recommendations of architects. The manufacturers and retailers were mainly interested in reducing the necessity of manufacturing and carrying stocks of little-used patterns. It was believed that better sales would result through concentration of a limited number of patterns recommended by architects designed to give approved artistic effects. With minor changes the patterns were approved by the conference and referred back to the lumber manufacturers for adoption.

Association action on lumber grades and nomenclature is being deferred until action is taken on sizes. In addition to nomenclature, the work of the Forest Products Laboratory has been largely centered on fundamental work, such as the definitions of defects and the determination of equivalent defects which are necessarily the foundation stones in standardizing lumber grades.

Standardization of building materials, such as lumber, has been a long-felt need throughout the country, and the progress attained thus far has not only been highly commended by national engineering bodies and the consuming trade, but the final adoption of standard grades and sizes will close a very progressive chapter in the history of the lumber industry.

BRUSH DISPOSAL IN WESTERN YELLOW PINE

By G. A. Pearson

What method of brush disposal is most favorable to reproduction of western yellow pine? This is a question which the Fort Valley Experiment Station has been endeavoring to answer during the last 12 years. A definite and unqualified answer has not been possible for the reason that, owing to the slow movement of the natural processes involved, it has been difficult to secure conclusive data on the subject. There is a widespread opinion among silviculture men that the chances for reproduction are increased by leaving the brush upon the ground in some form or other, either scattered, lopped, or pulled tops. This opinion is based upon observation that in old cuttings where reproduction is generally deficient, more seedlings are usually found along logs and fallen tree tops than in the open. An experiment initiated in 1908, in which brush was scattered on portions of the area while other portions were left in their natural state, has given negative results. In 1914 brush was scattered on strips in a small plot which had previously been plowed and heavily seeded to pine. At the present writing seedlings are nearly three times as numerous on the brush-scattered strips as in the openings. In this instance, the scattering of brush appears to have been a decided benefit. Examinations of numerous cut-over areas show a similar tendency, though in a less pronounced degree. On no timber-sale areas known to the writer, however, has the presence of brush in any form proven a really effective aid to reproduction.

The extraordinary seedling crop of 1919 has afforded unprecedented opportunities for studying this problem. Examinations on various cutting areas on the Coconino and Tusayan this fall show that as a rule seedlings are by far the least abundant in pulled tops; they are most numerous and of largest size on bare spots such as burned brush piles, old roads, and areas around the stumps of felled trees. Open grassy areas are intermediate between the two extremes. In the few brush-scattered areas available for study, results approach pulled tops or open areas according to whether the brush was scattered densely or openly.

Though the above results apparently contradict previous ones, the divergencies may be readily reconciled. The better survival along logs and tops is due almost entirely to protection against sheep injury. Germination is usually less in the brush owing to excessive litter (under certain conditions it may be better than in the open); and mortality is greater during the first two or three years due to the rank growth of grass with which young seedlings are unable to compete. In brush, particularly unlopped tops, the grass is scarcely grazed at all and consequently makes a more luxuriant growth than where it is subject to grazing. A few seedlings do survive in the brush, however, despite competition with the grass, while in the open practically every seedling is destroyed by sheep. The bare spots such as burned brush piles, roads, and stump areas, where seedlings are most numerous to begin with, are just the places which are hardest hit by the sheep. This is due to the fact that what forage grows on such spots is of the succulent weed type; hence sheep tend to concentrate there. The growth of seedlings on such spots where protected against sheep is astonishing. When brush is placed on such spots, or wherever the grass has been exterminated, excellent seedling development results, due to the fact that they have the benefit of the soil mulch without being subjected to competition with the grass. This explains why such excellent results were obtained on the 1914 experimental plot where *the ground was plowed* before scattering the brush, thus eliminating the grasses.

I have outlined only the most essential facts brought to light by this season's study. There are a great many apparent exceptions to these statements, all of which are traceable to special conditions, and may be readily explained. The underlying fact is that western yellow pine seedlings thrive best where the entire soil moisture supply is at their disposal. Protection against wind and strong sunlight in dry periods is beneficial, but in the end it is detrimental if it is secured at the expense of the seedlings being robbed of soil moisture by a rank growth of older and better established plants, such as bunch grasses and other perenials.

The practical application of the foregoing conclusions is that pulling tops is not beneficial but is rather detrimental to reproduction, excepting that it serves as a temporary protection against sheep. Under unrestricted sheep grazing, pulling tops is beneficial in a limited way for a few years; but as a means of promoting reproduction it is wholly

ineffective. Under controlled sheep grazing (preferably none), but with moderate grazing by cattle and horses, good results can be secured by either piling and burning or by scatteding openly enough to permit free access by cattle. Which of these two methods will give the best results will depend upon the period elapsing between logging and the first good seed crop, and a number of other factors such as character of herbaceous vegetation and intensity of grazing. The outstanding fact is that method of brush disposal is insignificant in comparison with control of sheep grazing. Under proper control of sheep grazing fairly good reproduction can be secured under any method of brush disposal, assuming that fires are kept out; but without control of sheep grazing reproduction will rarely be successful under any method of brush disposal.

THE DEVELOPMENT OF A BRUSH-DISPOSAL POLICY FOR THE YELLOW PINE FORESTS OF THE SOUTHWEST

COMMENT BY THEODORE S. WOOLSEY, JR.

Consulting Forester

Professor Chapman gives a valuable history of the development of brush disposal in District 3, where the problem is especially interesting because of the long dry seasons and the consequent loss to regeneration through drying out of seedlings. Obviously the best procedure is the result of years of expense and evolution. On the other hand, one must guard against conclusions based on observations during an unusually wet season.

There are a few statements in the article which are worth further discussion, particularly the "Standard instructions for brush disposal on the National Forests of New Mexico and Arizona, except Coconino and Tusayan Forests," issued by the district and quoted by Chapman.

Speaking of brush burning, Chapman says: "The summer rains of the whole offer the best opportunity to an alert officer." The summer is the busy field season and hence unsuitable. There is always danger from fire damage to nearby trees but especially in summer where the ground dries up after rains. From my own experience the best time for brush burning is after the first snow fall, or in the spring before the fire season and before growth commences. A good deal must depend on the season's climatic conditions whether the fall or spring is best, and the main object of burning must be emphasized—namely, to reduce the fire risk—therefore the *partial burning* of a pile is usually sufficient, if the needles are all cleaned up by fire. The clean complete incineration so often the aim seems to me to be unnecessarily expensive. I believe the tendency will be away from refinements of brush disposal rather than towards elaboration. As a general rule has not the Forest Service spent too much on pure brush disposal rather than too little—notwithstanding the fact that the cost does not come out of the appropriation, but instead out of the gross timber sale receipts? As early as 1907 the acting supervisor at Flagstaff proposed fire lines with partial brush disposal instead of wholesale brush work on the Greenlaw

sale, but the recommendation was not approved by Washington. But by using ranger labor for burning brush, the first timber sale fire lines had been constructed on the first Saginaw and Manistee in 1906—the brush being burned without damage in the spring just before the snow had entirely melted and while the ground was still soft.

To intelligently review the district fire instructions (quoted by Chapman) my comment has been placed opposite the paragraph discussed:

D. 3—Instructions.	Comment.
"All brush shall be thrown or removed to a distance of 10 feet or more from the nearest living tree of a commercial species. For trees with live crowns extending to within 15 feet of the ground, this distance shall be measured from a point directly below the outer edge of crown. For trees whose live crowns are higher than 15 feet, it shall be measured from the bole, provided that brush need not be moved more than 25 feet to attain this result. Where the close spacing of trees does not permit the brush to be placed at a distance of 10 feet from living trees by moving it 25 feet, it shall be removed as far as possible from the boles of living trees, and shall, in all cases, be removed at least 10 feet from the crowns of trees over 12 inches in diameter, even when such trees are standing within groups of smaller trees."	Are not these instructions rather complicated and involved? There appears to be need for revision and simplification. Would the instructions be simple and clear to the average lumber executive?
"On fire lines all brush resulting from logging must be piled and burned. Logs, down timber, and dead tops, or other inflammable material whose presence would tend to render the fire line ineffective, shall be burned, though logs and down timber, except tops, may be skidded off the fire line instead.	Is it practicable or necessary to burn or skid "down timber, and dead tops" which would probably have to be cut into shorter lengths before skidding? It seems inconsistent to require the foregoing operation and not to require "the removal of ordinary forest litter." The fire line aims at stopping a general conflagration.

"The removal of ordinary forest litter from fire lines will not be required.

"The brush piles on fire lines must be placed at least 25 feet from trees over 10 inches in diameter and as far as possible from smaller trees. The piles should be large and compact, except when small piles are required in order to avoid destruction of tree crowns in burning."

The brush burning reduces the intensity of a fire to burning grass and litter. But should not a furrow be plowed through the center of the fire line so as to give an immediate vantage line from which to back fire. *Judging by fire practice in British India and Canada the furrow or cleared space is the essential.* Especially in open park line forests. Where practicable, and instead of a plowed furrow (where litter might collect) a path or open road might be substituted. In the very next paragraph the instructions say "Fire lines are intended * * * to furnish lines from which to back fire." Without clearing the "ordinary forest litter" will they accomplish their objective? A fire expert says: "It would be far preferable to make a narrow line more on the order * * * used in actual fire fighting. This would mean say a line 25 to 50 feet wide cleared of all slash * * * with a trench 3 feet wide cut to mineral soil near the outer edge." Could not a gasoline plow be used efficiently? Is it possible to pile brush "at least 20 feet from trees over 10 inches in diameter?"

"Fire lines will be planned along edges of slash adjoining timber which is not to be cut immediately."

Should not these lines be extended *into the uncut timber* 200 feet back from the slash on the ground they would be more effective. The furrow suggested in the last paragraph of comment should be where the stand is lightest.

"Fire lines, natural or constructed, should occur at not over half-mile intervals, and the area of continuous slash should not be more than 160 acres, or be *five-eights of a mile in any one direction.*

"By utilizing natural features, it is expected that the mileage of standard fire lines, whose construction is

Draw a diagram of a section where the section is (*a*) diagonally crossed by a ridge from N. W. to S. E. and (*b*) with railroad spurs tapping the section diagonally from the N. E. and S. W. Then decide on the best location of fire lines from the standpoint of fire protection. Are the instructions consistent or practicable?

necessary to give this degree of protection, will not *exceed four miles per section and may be less.*

"Fire lines should usually follow all railroad spurs, except when these are located at intervals smaller than required by the standard, and should always be constructed along main traveled wagon roads.

"The location of fire lines should avoid low crowned conifers and coniferous reproduction. *If this is impossible, it is better to destroy these crowns by burning on the fire line.*"

Usually railroad spurs are in the beds of canyons (except on Coconino and Tusayan) where undergrowth, brush, and litter are thickest, and is not the ideal place to construct a fire line, except from the fact that the railroad grade is one fire line itself. From every standpoint of preparation and results at times of fire, I should say that fire lines may be preferably located on ridges and out of canyons or ravines instead of in them.

It is believed the destruction of seed by wholesale brush burning should be given more emphasis, as well as the need for the annual clearing of débris from parts of fire lines. The more consideration seems to be: What sort of a cleared line can be better fired from? To my mnid even a narrow cleared path is better than the wide lines described by Chapman where the litter remains. Best of all is the wide general line with a narrow cleared area to back fire from. There appears to be too much theory and not enough "practice" in the district instructions. The main reason is that if the fire line principle is accepted in place of wholesale brush disposal then fire line technique should apply. The operator, even if he plows furrows, will still save money in gross costs. These instructions are a step in the right direction but the technique seems at fault.

FOREST DESCRIPTIONS ON THE FOREST SURVEY OF THE GROTON STATE FOREST, VERMONT

By Russell Watson,

Assistant Professor of Forestry, University of Michigan[1]

In attempting to gather, efficiently and well, those silvical and silvicultural data necessary in the preparation of working plans for the Groton State Forest, Vermont, a form of forest descriptions was developed, based upon a new conception of their value and use in this country. Nothing, at least, of the kind is found in the recent literature. It is believed, too, after several months' trial, that by the use of this form more expressive information can be obtained about a stand of timber to be handled for forestry purposes than can be obtained by the methods of forest description generally employed on forest survey work. Since the forest description may play a very important part in collection of data for working plans, a description of the form we used may be interesting to foresters generally.

When preparing plans for the forest survey on this forest property we had two main questions before us, namely, just what information and data do we want to gather on the survey and, how shall we proceed on the survey to get it?

In answer to the first question, we said that such information was wanted as would enable us to prepare feasible working plans for the property. State Forester Hastings wanted the plans so detailed that practically every acre would be taken care of during the coming 20-year period. It was the object of the plan, primarily, to indicate how to build up and put in order the forest growing stock which, as a result of lumbering and fire, is in a wretched run-down condition, having many undesirable species and not well stocked. The plan, therefore, would be primarily one of silviculture; but with proper regulation and distribution of age classes clearly in mind for the near future.

The detailed silvicultural information necessary to do this for practically every acre on the property, we decided, should be gathered

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mostly on the forest description sheet. And this forest description sheet should be written by the men on strip line during the course of the work of mapping and estimating.

Answers to the following questions were wanted for each acre of the property:

Is it plantable or not plantable? Why? Does it need planting? If so, when should it be planted, with what stock (species and age), how many trees per acre? Is the case one of underplanting or outplanting?

Should thinnings or cuttings be made? When and of what kind?

What silvicultural system should be used in harvesting the stand? When should it be harvested?

Is any special protection needed?

What species of tree or trees should dominate in the stand for best results? When should the area be examined again?

What is the quality of site?

What is the density of the stand? i.e., is it well stocked or poorly stocked?

If to these questions answers of reasonable correctness could be obtained for each 10-acre area on the forest (which would be, practically, for every acre of the property) much of the most desired information necessary for the working plan would be at hand. The timber estimator tallied every tree, one-inch in diameter in size and up on the strip and the data thus obtained were of much assistance here.

In preparation of the forest description form we used most helpful suggestions obtained from Filibert Roth, Professor of Forestry, University of Michigan.

The forest description sheet is simply a *questionary*. The questions printed on it are essentially those asked above. We decided to print such questions that in answering them the forester would be forced to think about the stand in terms of silviculture. Ordinarily, when in the woods, to think this way is not easy. A man is busy making mental pictures; his mind does not easily originate questions concerning the silvics or silviculture of the stand. For when in the brush he is rarely entirely at his ease; he is not in a quiet warm room in an easy chair. He is usually physically uncomfortable, is tired, bothered by flies or mosquitoes, wet and cold. He forgets to make the observations he should make. For these reasons our questionary was as complete and definite and detailed as we knew how to make it in accordance with the results desired of it.

The questions, of course, were worded so as to be purposeful and appropriate to the region. We decided to break away from the commonly accepted forest descriptions that only ask such questions as soil depth, moisture content of the soil (an old chestnut of a question anyway), amount and kind of brush, herbaceous growth, and so on. Very few indeed of the thousands upon thousands of such forest descriptions that have been written in this country have ever been used to advantage. It is believed that a better plan is to ask directly of the woods those questions to which answers are desired, rather than to describe the characters belonging to the stand and then to attempt later, in the office, to correlate these descriptions so as to answer the silvicultural questions. A stand of timber is a complicated proposition; answers to questions concerning its management are to be found in numerous observations; and many of these observations are not easily described. How, for instance, can a man easily describe the distribution of seedlings on the ground? A report may state that there are 1,000 healthy seedlings per acre in a stand, and that they are found in groups; but yet this does not tell one who has not seen it whether the reproduction on this piece should be supplemented by plantings. Before deciding one wonders about size of groups, density, number of seedlings in the group, and so on. And how can an area be described so that one who has not seen it will know whether or not it is physically plantable (except in extreme cases—as bare rock)?

Certainly the simpler way is to decide on the answer to the question while one is standing on the ground and then to write down the answer bluntly, with brief reasons.

So we wanted of our forest questionary (or forest description) several features, namely, first that the questions asked should be definite ones, second that all the information desired should be obtained through pertinently put questions, leaving as little as possible to "remarks," third that the questions be appropriate to the region being covered, fourth that all questions be purposeful to the solution of the task at hand, i.e., that the questionary be as complete as possible but be not overburdened with trivial queries, and, lastly, that the questions be put so that all answers should be uniform in kind and accuracy and easily applied to the problems at hand.

These features had to do with the silviculture in the plan, i.e., the collection of silvical facts and their co-ordination through contemplation of them, into definite, accurate statements, of methods to be

followed. Whether or not this part of the work was well done is difficult to prove, except as will be proved by the fruits of the plan which will appear with the years.

But forestry is not only a science but also an art, for it is the art of forestry to collect facts efficiently and well, and the degree of efficiency with which the facts are obtained oftentimes is an indication of the success of the work. Indeed, this is, unquestionably, a large criterion of the success of forest surveys.

It was determined, thus, what was wanted of the forest questionary. But a problem was presented in attempting to get these questions onto the sheet in good form. We wanted them all on one side of an 8½ by 11 inch sheet; and in such a simplified and abbreviated manner that the sheet would not be repelling to the cruiser on account of apparent complexity; and it was desired that the questions be asked, if possible, in such a way that answers could be made by check marks (√) rather than by writing in words, for when fingers are stiff from cold, writing is often difficult. Also the check mark occupies less space than a word. Indeed, the mechanics of the form, i.e., how to ask the questions and what style of an answer should be given to them and how to space and place the questions on the sheet, bothered more than a little. Not only were replies to questions desired, but also, when opportunity offered, in black on white, the reasons which led to such answers.

The sheet practically divides into three parts, namely, Dendrology, Silvics, and Silviculture. These divisions follow naturally. Dendrological and silvical information is necessary in preparing a plan of silvicultural plans noted.

Species	D. b. h.	Ht.	Age	M. H.	D. i. b. M. H.	400 N. D.	Site quality	Dominance	Defect, percent	Bole	
										C. L. M.	S. C. M.
1											
2											
3 etc. to 10.											

Abbreviations:—M. H. = Merchantable height; C = Clear; L = Limby; M = Medium; S = Straight; Cr. = Crooked; M = Medium.

	Main stand				Poles				Reproduction		
Species	Dis.	Density	Thrift	Cause of thrift	Dis.	Density	Thrift	Cause	Dis.	Thrift	Cause
	Cl. Ev.		G. P.		Cl. Ev.		G. P.		Cl. Ev. No. per acre	G. P.	
	Cl. Ev.		G. P.		Cl. Ev.		G. P.		Cl. Ev. No. per acre	G. P.	

[Etc. for 100 spaces]

Abbreviations:—Dis. = Distribution; Cl. = Clumps; Ev. = Evenly; G. = Good; P. = Poor.

	History of species			What will happen if left alone for..........years		
Species	Culling	Fire damage	Crowding	Main stand	Poles	Reproduction
	None Light Heavy Date Sizes	None Light Heavy Old Recent	None Light Heavy Old Recent	Gain–Loss Light Medium Heavy Cause	Gain–Loss Light Medium Heavy Cause	Gain–Loss Light Medium Heavy Cause

NOTE:—Space is allowed on the form for four species; often several species of similar habits may be grouped together. The gain or loss under "what will happen, etc.," is observed in terms of relative number of stems, not by volume. The cause of gain or loss may be growth, death through shade, or old age, etc. This is a most important feature of the silvical description.

The species selected are the species that make up the stand. Space is prepared for ten trees. The individual trees selected are representative of the trees of the stand; generally average trees of the main stand are selected. Thus, heights of trees are obtained; and this information is valuable not only in determining what volume tables should be applied (in case log lengths are not to be obtained by the estimator) to obtain volume of stand, but also the position of the tree in the stand and often the quality of site. For example, in mixed, even-aged stands of yellow birch (70 years old), paper birch, red maple, and bird cherry and red spruce, on this form can be shown the height and age of the individual species, e.g., paper birch, and red maple the tallest, yellow birch and bird cherry next, and the spruce as subordinate, all the same age. Other columns give merchantable height (M.H.) diameter inside back at merchantable height (d.i.b. M.H.) and Schneider's formula for growth per cent $\frac{400}{\text{N.D.}}$ and these data are

gathered when intensive silvical studies are made in stands (as was done in all typical stands on the property). If one wishes to show that the stand is of all ages, several individuals of the same species may be taken; if time is not at hand to obtain age, the diameter will indicate it roughly.

Under silvics are found matters of main stand, poles and reproduction, with questions as to distribution, density, crown cover in main stand, and general thrift of the species. "History of species" is information to indicate why the present stand is of the character that it is. The questions under "What will happen if left alone for ...... years" (we usually used 20 years here) immediately bring the describer's attention sharply to the changes which will be produced in the forest through growth or other obvious causes.

The chief value of this questionary, however, is found under the Silvicultural questions under "The stand." Here is information needed in silviculture, regulation, utilization and protection. In general it is self-explanatory. If it appears unnecessarily detailed it must be remembered that the form was prepared to take care of every forest condition which might be met in the mixed hardwood and coniferous forests of Vermont.

It will be noticed, also, that many of the questions in silviculture are based directly upon the data and observations recorded under the dendrological and silvical part of the questionary.

....
(Date and name)

....
(Location)

THE STAND

Site { Very Good / Good — Medium / Poor — Reasons

Undergrowth...
(Density) (Species) (Height)

Terrain for logging: Easy, Medium, Hard...............................

Plantable: Present........... Future............Yrs.... ... Never........

Reasons:..

	Stocking		Culling of stand		
	Density	Percent area covered	Species	Degree	Year
Main stand					
Poles					
Reproduction					

Silvicultural System to be Used:

Clear Cut { N. R. (i. e. Natural Reproduction) / A. R. (i. e. Artificial Reproduction) Shelterwood { N. R. / A. R.

Selection { N. R. / A. R.

Care that Stand Needs Now—10 Years

Improved cuttings? Yes No

For Composition ....

For Liberation ....Thinnings......................

Trees to be cut				Trees to be left			
Species	D. b. h.	Species	D. b. h.	Species	D. b. h.	Species	D. b. h.

Special Protection needed: Insects.......... ....

Fungi, Fire...................... ....

Planting Needed? Yes. No.

	Acres	No. per acre	Species and age
Unpl.			
Outpl.			

Care Stand Needs 10-20 Years Hence:

Cleanings........................ Liberations............ ....

Thinnings......................... Planting ....

When should harvest ....

Examine again: 5-10-20-30.................years.

All this is printed quite easily on one side of an 8½ by 11 inch page, with room enough for eight rules lines, 7 inches long, for "Remarks."

On the reverse of the sheet are found the following questions:

THE PLOT

Slope ....Aspect ....Altitude ....
Topography: Flat, bench, slope, upland, upper slope, lower slope, lowland, stream bottom, rolling (gently, abruptly).
Soil (kind, depth, moisture)...
Farm land (Yes) (If No give reasons why)....................................
....
Plot location (Compartment) ....(Sub. compt.)................
Size of plot..........................Applies to..........................
....

....
(Signature of Examiner)
Date..

This is used in sample-plot work and in examination of wood-lots where no topographic map is prepared.

Each sheet covers, usually, 600 or 700 feet along the strip line. If changes occur in quality of the site or in the forest composition a separate sheet is written for each marked change in forest conditions. For best results the work should be done by a third man in the crew; he should not do estimating or mapping. However, where the topographic work is easy and estimating slow, the topographer may be able to carry on this forest description work. Or again, a third man may be dispensed with if the estimator has but little to do.

It was suggested that we include questions regarding fire hazards, condition of roads and trails, opportunities for administrative sites, and so on, but these we felt were hardly pertinent in this detailed set of silvical questions. Such matters are general in scope and information regarding them need not be gathered on the strip survey.

One drawback to the use of this form is that it demands for successful completion, such forest judgment that only technically trained foresters can use it. This feature precludes its use by many of the men that one is forced to use on forest survey jobs.

STUDIES IN RETARDED GERMINATION*

ABSTRACT BY E. C. ROGERS

Dr. Puchner informally classifies seeds as to promptness of germination into these classes:

1. Seeds which are at once capable of germination as soon as they reach maturity on the mother plant as aspen, elm. Such seeds must be sown at once after ripening, before their vitality disappears.

2. Seeds which may germinate also very quickly after ripening but not so promptly as in Class 1. These obtain their vitality for a longer period, e.g., the most of the cereals, radishes, the Brassicae, and the "Kleeartigen Gruachse." According to many observations [1] it appears "useful" not to sow many of these seeds immediately after the harvest. They germinate better when a certain period of storage precedes the sowing. With such seeds the conditions of "Schnittreife" and "Keimungsreife" do not completely coincide.

3. Seeds of many trees and flowers, in which "Schnittreife" and "Keimungsreife" are separated in a pronounced manner by a longer or shorter so-called "Samenruhe" or "Keimruhe." This last class is again divided by the author into: (*a*) Seeds which, although capable of quick germination, are held back by the development or formation of the seed coat ("Hartschaligkeit"), e.g., many of the Papilionaceæ. With these seeds not all individuals are thus delayed, only a limited number of them. (*b*) Seeds in which the delay is not confined to certain individuals but which is the rule. Impermeability of the seed coat does not apply here, e.g., yew, ash, cherry, hawthorn, the Pomaceae in general, many palms among the trees and Primula, Oenothera, Canna, Polyanthus, Viola, Phlox, Gentian, Verbena, and most of the monocotyledonous plants among the flowers.

Dr. Puchner mentions as an example of "Hartschaligkeit" vicia villosa or sandvetch and discusses it briefly, attributing its delayed germination to the position and character of the palisade cells of the

*Untersuchungen über verzögerte Keimung. (Naturwissen schaftliche Zeitschrift für Forst und Landwirtschaft). (13:159-178, Apr.-May, 1915.) By Prof. Dr. Puchner of the Kgl. Bayer, Saatsuchtanstahl im Weihenstephan.

seed coat which lie one against another without breaks between. The outermost cells are overlaid with a cuticle which defies the entrance of water (even when the latter is very abundant) through the "Hartschicht" into the "Quellschicht" and on into the interior of the seed. This "hard" condition of the seed coat varies widely with individuals, from almost none to those where the delay occasioned thereby is so long protracted that the seed at least from a practical standpoint must be considered as infertile.

In determining the fertility of seeds individuals which remain unswollen at the end of the test can not at once admissibly be rejected as useless unless they show signs of decay. Nobbe has recommended that a third of such seed (with clover and the like) which remained fresh and hard after 10 to 12 days in the germination bed, should be added to the germinated seed, in calculation of the percent of fertility.[2]

As with many other "hard shelled" seeds, Vicia villosa often holds over on farmed fields until another crop has been planted, thus becoming a troublesome weed. This point has caused it to lose in favor among farmers.

The author describes his seed tests of Vicia villosa seed. Two samples of 100 seeds each, one untreated and the other wounded slightly on the tests with a small knife, were placed in an "Aubryschen" germinating chamber in November, 1899. Plenty of moisture was provided, with regular aeration, and with artificial heat in winter. With the wounded seed, *every one* germinated in 17 days, while 60 per cent of the unwounded had germinated in that period, 85 per cent in 37 days, 97 per cent in 1 year, 99 per cent in 5 years, and 100 per cent or *every seed* had germinated after 12 years. The author does not claim that results would have been proportionately entirely alike had the seeds been sown in the open field, but thinks that the course of germination would not have been greatly different.

That in cases where the "hardshelled" condition of seed coat is present normal germination will be induced at once by artificial wounding of the seed coat has long been known.[3] Nobbe used this method with success in 1871 with seed of Tetragonolobus purpurens (Kneifelrobse). However, the wounding must be deep enough to penetrate the hard layer. Lakon [4] found that a slight paring off of the cuticle of seeds of Gladitsia triacanthos was ineffective but that after a deeper filing the seed commenced to swell within a few hours.

The seed trade and the technic have long made use of such practice. Many large seed firms treat those seeds which are known to possess "Hartschaligkeit" before selling them, using machines in which the seed are thrown by centrifugal force against the inner walls of a rotating vertical or horizontal cylinder, these inner walls being covered with a rough wearing surface. The speed of revolution and the degree of roughness of the inner walls are of importance, the faster the former and the greater the latter, the deeper is the seed coat injury. The vertical cylinder owned by the firm of J. & P. Wissinger Company of Berlin is ordinarily run at the rate of 750 revolutions per minute, the seeds being thrown against a stationary "Schmirgel (emery) kranz" which runs at the ends in an iron band with cross slits, through which the fallen dust is sucked off by means of an exhaustor and liberated in the open. For larger seeds the number of revolutions must be lessened.

The treatment of the seed coat with sulphuric acid (Hiltner process)[5] which produces a breaking down of the hard layer is sometimes used. Lakon[6] found that a two-hours soaking of Gleditsia triacanthos seed caused the hard seeds to prove at once capable of germination.

Most tree seeds excepting those of the leguminous trees, the willows, birches, elms, etc., belong to group [3b] before mentioned, i.e., delay in germination is the rule rather than confined to certain individuals, while water and oxygen exclusion is not present. Nobbe's[7] work with two related wild species, Thlaspi arvense and Thlaspi alpestre is mentioned. The seed of the latter have a delicate, gold-brown color, and germinated rapidly up to 81 per cent in 11 days. The seeds of T. arvense, however, of a dark brown, hardshelled appearance, germinated 3 per cent in four weeks. This looked like a case of Hardschaligkeit, but on cutting open these seeds of T. arvense after four more weeks had passed showed them to be moist and sound throughout. This was also observed with seed of Euphorbia lathyris and Pinus Cembra.[7]

Delayed germination of a species calls forth two questions, (*a*) the theoretical. How is this peculiar delay brought about? (*b*) the practical. How can it be shortened?

The custom of some gardeners to carry seeds of certain cucurbits about in their pockets, e.g., cucumber seeds, in order to hasten germination after planting, is mentioned. It is possible that heat and moisture from the body may bring this about.

Seeds of Eu. ash, hornbeam, and late-blooming bird cherry, usually require a "Keimruhe" of 1½ years. The popular belief is that seeds

of these species germinate well the first season, if sown a tonce in the fall, or if soaked in warm water before sowing. However, the greater proportion hold over until the second year.

The author, in order to learn the effect of wounding the seed coat of ash (*Fraxinus excelsior*) and hornbeam (*Carpinus betulus*) seeds, placed 100 of each untreated in an "Aubryschen" germination chamber in the fall of 1899, together with 100 of each which had been wounded with a penknife on their broad surface. These were all perfect specimens.

With the ash seeds, 100 per cent of the wounded seeds decayed within 190 days. Of the untreated seeds, not a single germination took place until April of the second spring after starting the test (or 528 days). Germination then proceeded very slowly until 6 per cent had germinated in 4 9-10 years. The last germination occurred after 8 3-10 years, making a final record of 11 per cent. The other 89 per cent had rotted.

With the hornbeam—every wounded seed decayed, but 4 4-10 years were necessary to bring this about. The first germination in the untreated sample took place 618 days after the beginning of the test, in 1 9-10 years, 10 per cent in 3 3-10 years, 25 per cent had germinated, while the last germination was recorded 4 9-10 years from the beginning, making a final germination of 32 per cent, 40 per cent of the remainder had rotted, while the remaining 28 per cent proved upon being cut open to be entirely hollow.

Evidently here the seed coat is no bar to the entry of water and oxygen and no advantage attends its wounding, every wounded seed decaying sooner or later. The writer thinks that the flat-lying position of the wounded seeds may possibly have led to the knife cuts going too deep and to a consequent injury of the embryo within, resulting in inability to germinate and in decay. On the other hand, he thinks it more probable that a certain period of "Keimruhe" is normal for the seeds in question, regardless of the condition or character of the seed coat. The injury of the seed coat may permit the entrance of fungi which attack and overcome the embryo before the period of natural rest has been completed, thus preventing germination.

The failure of filing and cauterizing the seed coat of seeds of Pinus cembra as reported by Lakon [6] is mentioned.

Hiltner's belief [8] that lower soil organisms are very destructive to seeds particularly before they have sufficiently developed to resist the

attack and that the treatment of seeds with sterilizing solutions is of great advantage, seems to be quite strongly borne out here.

It seems possible that there is some relation between the heavy loss from soil organisms and the abundant annual seed crops of the ash in particular, but also of the hornbeam. Perhaps the latter is a natural measure to preserve the species.

That the decay of the ash seeds in above-mentioned test proceeded more rapidly than with the hornbeam seed, is probably due to the thicker, firmer seed coat of the latter. Many seeds of the hornbeam appeared for a time to be covered with fungous growth, but later this disappeared and germination took place. Many seeds of both species were completely consumed within without any noticeable break in the seed coat.[9]

The writer discusses the extent of the delay of germination in the seeds which sprouted. He notes that Fraxinus excelsior requires a longer "Keimruhe" than Carpinus betulus and expresses the opinion that this long rest is accompanied by a lengthened danger of destruction by fungi. Lakon's view that the embryo of a Fraxinus excelsior seed before germination must first develop to sufficient size to completely fill a chamber-like space between the two halves of the Endosperm [10] is mentioned. Lakon holds that the embryo at the time of ripening occupies only a part of this space and that it commences growing upon being exposed to germination conditions. The writer finds, however, that seeds in which the embryo has developed to completely fill the space were not yet able to germinate, but seem to await the application of some external stimulation and he believes the development of the embryo (Lakon's "Vorkermung") to be not sufficient in itself to insure germination. As to the external stimulus indicated, the writer's experience would tend to exclude mechanical treatment. Yet Lakon found that sustained pressure upon the swollen seeds in which the embryo within had fully grown caused a prompt pushing out of the radicle. Such pressure could be brought about in nature by volume changes in the overhead soil layer through alternate drying out and becoming moist, by the rubbing of the seed on hard soil particles, by violent air movements and by the running and digging and crawling of animals.

Other stimilii [11] suggested are oxygen supply, light [12] and air electricity.[13] Kinzel has found that light cultures of ash seed germinate much faster than dark cultures. In both Fraxinus excelsior and

Carpinus betulus tests above described not a single germination took place during the 3 months of November, December and January. It is noted that the atmosphere of the laboratory was particularly poor in oxygen at this season while daylight and air electricity are weakest during this period. It has been found in practice that ash and hornbeam seeds tolerate only a very shallow soil covering. This can be explained on the grounds of oxygen and light requirement.

Duvernoy's studies of the seed of Colchicum autumnale and Arum maculatum are briefly referred to.[14]

In the before-described tests some of the sprouted plantlets appeared not to have grown out but to have been thrown out of the seed shell, the empty coat being found several millimeters away.

The writer's tests being carried out between moist filter paper in a poorly lighted and aerated germinating chamber may have increased the delay. Kinzel [15] has obtained as high as 40 per cent germination of ash seed in lighted petri dishes. He (Kinzel) was unable to hasten germination by freezing the seeds, which in a moist soaked condition are very sensitive to lowering of temperature.

To find out whether ash seed which had wintered in the open would sprout more quickly than that which was gathered in the fall, the writer tested samples of seed which was taken from the tree the spring after ripening, and also of seed which was gathered from the ground in June after overwintering in that position.

The seed overwintering on the tree required 5¼ years to complete germination, giving a final record of 8 per cent, the other 92 per cent having decayed.

The seed which over-wintered on the ground required 7¾ years to complete the germination which finally reached 20 per cent, the remaining 80 per cent having decayed. Again, no germination occurred during the test in the months of November, December, and January. Decay proceeded much more rapidly with the seed taken from the ground, in spite of the better germination of that sample. This leads the writer to conclude that these seeds were exposed for some time to infection while lying on the ground. The poorer germinative capacity of the seeds wintering over upon the tree is thought to be due to immaturity.

It is evident, therefore, that allowing the ash seed to over-winter in the open does not shorten the "seed rest." This agrees with Lakon's [10] investigation who found no difference in the material composition of

seeds gathered in fall from the tree, or in spring from the tree, or on the ground.

The author repeats his former statement that his results being artificially brought about, can not be expected to be entirely the same, as natural germination in the open. Nevertheless, he believes that the behavior of the seed in the open would be much the same.

REFERENCES

[1] C. Kraus—Untersuchungen über die Reifungsverhältnisse der Gerste. Zeitschrift für die gesamte Brauwesen—1892.

L. Kiessling—Über die Keimung der Gerste, Ebende, 1906, No. 52.

A. Atterberg—Die Nachreife des Getreides—Landw., Versuchstationen, 1907.

L. Kiessling—Untersuchungen über die Keimreifung der Getreide—Landwr. Jahrb. f. Bayern 1 Jahog. 1911, No. 6.

[2] Rodewald—Zur Methodik der Keimprüfing—Landw. Versuchstationen, Bd. 49, S. 257-286.

Arbeiten der D. L. G. Heft 101, Bd. 19, S. 257-286.

Kirchner—Uber die Geraugk. d. Unters. v. Kleesëmerein aufihren Gebrauchswert—Fühlings Landw. Zeitung, 1901—S. 29 u. ff.

Arbeit 101 der D. L. G. Learbeitet, von Rodewaldused.

[3] Hiltner—Keimungsvehältnisse der Leguminosensamen. Arbeiten des Kaiserl, Gesundheitsamten III Bd. Heft 1, 1902.

[4] Lakon—Der Keimverzug bei den Koniferen und hartschaligen Leguminosensamen.—Naturw. Z. f. F. and Landw. 1911, S. 226, 232.

[5] Österreichische Zeitschrift für Zuckerindustrie, 1899, S. 18.

[6] Lakon—Naturwissenschaftliche Zeitschrift, f. F. Landw. 1911, S. 233.

[7] Nobbe—Handbuch der Samenkunde—S. 364.

[8] Hiltner—Arbeiten aus der biologischen Abt. f. Landw. und Forstwirtschaft a K. gesundheitsamte, Bd. III, Helf 1, 1912.

[9] Puchner—Über variabilität der Keimungsenergie und deren Willkürliche Beeinflussung. Festschrift zur Zentenerfeier der K. Akademie Weihenstephen 1905.

[10] G. Lakon—Beiträgr zur forstlichen Samenkunde II Zur Anatomie und Keimungsphysiologie der Eschen Samen. Metteilungen—aus dem Bot. Inst. d. K. Forst—Akademie zu Tharandt. Naturwissenschaftliche Z. f. F. V. Landw. 1911. S. 285.

[11] Vgl. die betreffende Zusammenstellung in L. Kiessling. Untersuchungen über S. Keimreifung d. Getreide. Landw. Jahl. S. Bayern—1911, S. 511.

[12] W. Kinzel—Über den einfluss des Lichtes auf die Keimung. Ber. d. Deutsch. Bot. Gesellschaft, 1907.

[13] V. Candiota V. F. Buccolini—Boll. technico della coltoragione dei Tabacchi (Scafati) 1902, I. 124.

[14] Duvernoy—Untersuchungen über Keimung Ban. und Wachstum der Monokotyledonen—1834—S. 54.

[15] W. Kinzel—Frost und Licht als beeinflussende Kräft bei der Samenkeimung —Stuttgart 1913. S. 61.

FORESTS AND HUMAN PROGRESS

COMMENT BY H. N. WHITFORD

A recent article by Zon [1] concerning the relations of man to the forest is deserving of more notice than is possible in a brief review. In a very admirable way he has brought together much of the evidence that deals directly or indirectly with the subject. Altogether there are some seventy-three citations to literature.

The study is primarily a consideration of the relations of mankind to the forests from an evolutionary standpoint. Beginning with the first stage, *civilization dominated by the forests*, homologous to the stone age, the developmental process passes through the period of *civilization overcoming the forests*, resembling the bronze age, a period in which mankind uses the forest thoughtlessly to aid his progress in the arts and sciences. Then the final stage, *civilization dominating the forests*, compared to the iron age, is discussed. In this stage nations realize that if they are going to have any forests to dominate, and supply them with useful products to further their progress, they must introduce cultural methods. In different parts of the world there are today all three of these stages.

In the first stage attention is called to the fact that the cradle of civilization was not in a primeval forest, for the earliest recorded civilizations originated in more or less arid regions. Next primeval forests as an obstacle to human migration is treated, including a very interesting discussion of the effect that the ancient European forests had on conquest and colonization. In the lower stages of civilization the population of the forest is shown to be sparse and the forests were used as natural boundaries. Instances are cited where the forests afford refuge for man, when he wishes to escape his more powerful enemies, or to carry on illegitimate businesses like brigandage or illicit manufacture of liquor. The tribes dwelling in the forest are found to be primitive in their living habits, often weak physically, and in spite of ethnological differences they have uniform characteristics, as regards their domestic, political, and social life. The author produces evidence to show that people like the eskimos who live beyond the limits of the

[1] Zon, Raphael. *Forests and Human Progress.* The Geographical Review, IX: 139-166; 1920.

forest are checked in their migrations by the driftwood that is brought to them by ocean currents from forested regions. Other subjects in the first evolutionary stage treated are the effect the forest has as a moulder of spiritual and religious life and the rôle that forests have played in folklore, poetry, and art.

Under the second stage, *civilization overcoming the forests*, the development begins with primitive methods of agriculture. The author maintains that this method could not change to any marked degree the forest cover of the earth for the tools used were too crude, and activity of the people was rarely concentrated, but was nomadic. In Germany alone there are 6,905 names of places which indicate their origin in forest regions. The use of forest products as a supplementary source of food for man and cattle began in the early settlements near forest regions. Stock was grazed in the open forests, nuts like acorns furnished food for man and beast alike, and in the neighboring forest wild animals were used for meat and hides.

The author claims that exploitation of the forests were the chief cause of their disappearance over large areas. He points out how rivers have favored this exploitation and consequently forests disappeared first along them. Only when steam railroads were introduced was it possible to reach forests far from natural lines of transportation. He points out the overcoming of the forests influences man psychologically, and while the backwood type often developed undesirable traits yet it nevertheless made *men*, and many of our great leaders like Lincoln sprang from this type of civilization.

With the spread of civilization the world's forested area has been much reduced but instances are pointed out where ancient civilization has declined, reforestation has reoccupied the area. It is shown that the original composition of the forest is in some instances profoundly changed by man.

The introduction to the last stage, *civilization dominating forests*, is worth quoting:

"Over a large part of the world the forest is now conquered. It is not only conquered, it is exterminated beyond any possible chance of natural recovery. It has now become important to civilization to preserve and restore the forest instead of struggling against it. Out of a land area of some 32½ billion acres there is little more than 5 billion acres remaining in forest—exclusive of brush land—or only one-sixth of the land area. The greatest change of course has taken place in Europe, where of a total land area of nearly 2½ billion acres there

remain now barely 750 million acres in forest. Even of this, two-thirds are found in European Russia and Finland and about 250 million acres in the rest of Europe. In some countries—Great Britain, for instance—nearly 95 per cent of all the original forest is gone. In France, Spain, Belgium, Rumania, and Greece, from 80 to 90 per cent of the original forest has been destroyed; in Bulgaria, Serbia, and European Russia exclusive of Finland, from 60 to 70 per cent; and in North America the original forest has shrunk from some 822 million acres to 463 million acres in the course of three centuries."

In spite of the disappearance of the forest, and the wider use of steel, brick, and concrete, more wood is used today than ever before. In 1880 the United States consumed annually 300,000 cords of pulpwood, today 6,000,000 cords are used. In 1911 the per capita consumption of wood in England was three times that of 60 years ago.

The evil economic and social effects of forest devastation is prominent. It is estimated that in the United States there are 80,000,000 acres of idle land once forested that is mostly unfit for growing agricultural crops.

The paper ends with calling attention to the new movement toward rational management of forests. The closing paragraphs are worth quoting.

"Nearly every civilized country at the present time has adopted or is considering measures for the perpetuation of the existing forests, or even for extending their present area. Thus England which, because of her insular position and proximity to countries still possessing vast forest areas and because of her cheap water transportation, could best of all get along with a small forest area has now, as a result of bitter experience during the war, worked out a plan for planting some 1,700,000 acres and providing a forest area sufficient to sustain her domestic needs in case of emergency for three years. France, which for over a century has been carefully husbanding her forests, is further elaborating plans for their careful management and is enlarging her forest nurseries for extensive planting. Germany, Switzerland, Italy, Norway, Sweden, and New Zealand are also considering means of increasing forest products. Even in our own country the maintenance and protection of existing forests has become a pressing question of the day.

"Nearly all of the forests now found in western Europe are man-made. With increase in population more intensive use of all resources became necessary, especially of those resources which through more intensive application of labor, knowledge, and skill could be made to produce more fully. Forests being a poor-land crop prove more profitable than agricultural crops on non-agricultural lands. The day

of the forester—the timber farmer—has now arrived in practically all densely populated countries of the world, and his work is to secure forest crops by human skill just as food crops are now being secured. Nor is the less material rôle of the forest being overlooked. In order to offset deterioration in the physical and ethical well-being of the people crowded in industrial centers with poor housing facilities, state and municipal forests are being established as a source of healthy recreation for the densely populated countries of Europe.

"The new forest may be different from the original forest which once occupid the ground. It certainly bears a more utilitarian aspect. The trees that are being grown are not always of the kind that nature would prefer to produce under given conditions of climate and soil, but are those which man needs most. Just as intensive farming has increased the production of the land, so the forester is now producing five to ten times as much useful material as nature unaided produced before. Although the man-made forest may not have the beauty and grandeur of the wild woods which were the result of the free play of natural forces, it has a new beauty—the beauty of orderliness and usefulness. It is no less an important factor in civilization from the ethical and geographical point of view, because at present the economic principle is applied to it, as it is now being applied to the raising of agricultural crops."

After reading the evidence presented by the author it seems to be the inexorable rule that nations do not begin the practice of better forestry methods until great inroads have been made on their natural forest resources. In the early stages forests overwhelm them, next they overwhelm the forest, using some of their products much like an unsportsmanlike hunter kills more game than he can possibly use. Finally, in those nations that have reached a high enough civilization to think of the future, a halt is called and better forest methods are introduced.

In spite of the many admirable features of Zon's articles there are some statements that cannot go wholly unchallenged. In his efforts to make a strong case in favor of the influence of the forest on human civilization, he has neglected other factors that are perhaps more influential. This is of course natural and perhaps due in part to the wide field covered by the subject.

Thus under the heading "Exploitation of forests the chief cause of their disappearance" is this sentence, "It is the increased need for the products of the forest itself, particularly its timber, that has made the heaviest inroads on it." Is this true? Even in the United States and Canada where modern logging machinery has been most rapidly developed, the inroads made by exploitation have not destroyed as great

areas as have fires. In fact, fire, man's chief agent for forest destruction, seems not to have been seriously considered anywhere in the paper. Is it not a fact that wherever a civilization has arisen on the border of a forest, that up to the time it has entered the third stage of dominating the forest, that its need for areas for growing crops and for grazing purposes is so great that it has deliberately destroyed a very high percentage of its forest area, both on agricultural and non-agricultural areas, at the same time using only a small part of the forest products? This is also true of many parts of the tropical countries that have been visited by the writer. In such countries where modern lumbering methods of logging have been introduced a larger percentage of the forest products are being utilized, but still much larger areas are being cut and burned for cultivation.

It seems to the writer of this review that the author has greatly underestimated the degree to which primitive people have dominated the forests. Thus on page 153 he states that "the primitive agricultural system, caingin making, of the Philippines could never have brought about the destruction of the forests, since the cultivator's efforts were never centered long enough in one place." A note at the bottom of the page supplements this with a quotation that "it is estimated that caingin making has destroyed over half the original forest cover in the Philippines. The abandoned areas quickly become covered with cogon grass and if kept free from fire forest ultimately comes back." As a matter of fact fires are uncontrolled, the control is centered on maintaining the remaining virgin forest areas, but in spite of efforts of forest officers large areas of forests are still being destroyed. The fact of the matter is that this primitive method of agriculture has dominated nearly three-fourths of the virgin forest area of the Philippines. Strange to say with their crude instruments they are better able to conquer the forest than rid the soil of the rank growth of grass with its net work of underground stems which fire will not kill. Here is a case where grass and not forests has dominated primitive mankind.

On page 140, in support of the contention that the early recorded civilization originated in arid regions, in a footnote the author quotes Huntington's theory that the ancient Maya civilization arose and flourished during a time of drier climate and that the succeeding moister climates favored the growth of a heavy type of forest that the Mayas could not overcome.

It is not clear that Zon supports this theory in its entirety for on pages 161 and 162 under the heading "The struggle between man and forest" he quotes from Cook's "Vegetation affected by agriculture in Central America," who presents evidence to show that many parts of Central America were deforested for purposes of cultivation by ancient primitive civilization and with its decline the forests again took possession of the land in many localities.

What Zon does not call attention to in this connection is that according to Cook many large areas once in forest have been replaced by grass and open pine and oak forests and kept so by fires. Following the quotations of Cook, Zon makes this significant statement on page 62:

"What is regarded by some geographers as evidence of a civilization that had arisen in the primeval forest is nothing but the remains of a civilization which succeeded in clearing the forest; with the decline of this civilization and favored by a warm and moist climate, the forest again took possession of the land."

What is important here is that according to present vegetation and other evidences, large areas of forests in Central America had been dominated for the purposes of raising food by ancient people, and is continued by their descendants, so that a large part of the vegetation of today is not virgin forest. Where completely abandoned it has recovered its virgin conditions. Other places, due perhaps to the remnants of the ancient civilization left behind, still remain deforested, and have perhaps continued in this condition since the forest was first cut. If one happens to be in the Motagua valley of Guatemala, one of the ancient seats of the Maya civilization, at the dry season of the year, he will find the air filled with smoke made by clearing mature and second growth forests for shifting methods of cultivation. Each year the forest scenery is still being "amputated," the crop planted but not cultivated, the jungle growth with grass driving the farmer to another area, only to return after another generation of trees occupy the area, or if fires prevail, as is often the case, the area remains deforested. The Mayas were undoubtedly a people of the stone age. They had none other than stone implements. Notwithstanding Huntington's change of climate theory, and the evidence he presents is not convincing, they probably reached great power, with a dense population in the higher cooler climates. They used up the virgin forest regions here, and gradually pushed into the lower moister valley in search of new areas

of virgin soil. When one region was deforested, and covered with grass they transferred the seat of their civilization to another. Huntington maintains they could not have cut down the forest with their crude stone instruments [2] but a people that could quarry, transport and carve the stone monuments they did, surely could cut down forests. This "cunuco" form of agriculture, as it is called in some Spanish American nations, prevails all through the tropics and is the chief cause of the destruction of the forests. Over these areas, in many places wide in extent, "the forest is not only conquered, it is exterminated beyond any possible chance of natural recovery."

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[2] In this connection the reader is referred to Lange's ("The Lower Amazon," pp. 228-230) description of diorite axes and the methods one of the Indian tribes of the Amazon used in cutting down trees, to make a forest clearing.

REVIEWS

Ecological Studies in the Tension Zone Between Prairie and Woodland. By J. E. Weaver and A. F. Thiel. The Bot. Sur. Nebr., N. S., No. 1, 60 pp., 38 figs. 1917.

Further Studies in the Ecotone Between Prairie and Woodland. By R. J. Pool, J. E. Weaver, and F. C. Jean. The Bot. Sur. Nebr., N. S., No. 2, 47 pp., 17 figs. (This number reprinted from Univ. of Nebr. Studies, Vol. 18, Nos. 1 and 2, 1918.)

The Botanical Survey of Nebraska, since its organization in 1892 by the Botanical Seminar of the University of Nebraska, has made steady progress in the study of the phytogeography of the State. Its recent reorganization by a new generation of botanists has marked a new era in which the older methods of the phytogeographer have been replaced by the more exact quantitative methods of the modern ecologist, as is evidenced by two of its latest publications.

The first monograph under review is based on two years' work by Weaver and Thiel in the vicinity of Minneapolis, Minnesota, supplemented by similar work near Lincoln, Nebraska, and might in a way be considered a sequel to Weaver's work in southeastern Washington and adjacent Idaho.[1]

Physical factor stations were maintained in the high prairie, low prairie, hazel thicket, oak forest, and hard maple forest, where soil moisture, wind movement, evaporation, temperature, and relative humidity were recorded. The transpiration losses per square decimeter of leaf surface were obtained for potted seedlings of bur oak, white elm, silver maple, and green ash. The results showed in every case a marked decrease in transpiration when the plants were placed in the scrub community. The average loss in the prairie compared with that in the scrub gives the ratio of 100:53. The ratios of these transpirational losses in the scrub and prairie communities were found to vary with the species and with its former environmental condition. In general, the authors found a correlation between the water loss from the plant and the aerial conditions as summed up by the evaporating

[1] Weaver, J. E. A Study of the Vegetation of Southeastern Washington and Adjacent Idaho. Univ. Nebr. Studies XVII, No. 1, 1917.

power of the air. A rather close agreement was found in the evaporating power of the air in the various communities; the prairie was always the most xerophytic.

The following conclusions are quoted from the first monograph:

"The great amount of evaporation in the prairie coupled with low water content of the soil is a sufficient cause for the xerophytic character of the vegetation. It shows also the difficulties met by trees in establishing themselves in grassland and may explain their absence from the prairies.

"Plants placed in the more mesophytic scrub community transpire much less vigorously than others of the same species placed in the prairie. In general, there is a correlation between the evaporating power of the air and the amount of transpiration.

"If sufficient light is available, there is no question but that humidity of the air and the soil are the most important factors affecting the establishment of the different plant communities. The progressive increase of the humidity of the habitat causes a corresponding increase in the mesophytism of the plant community. This change of plant population from the xerophytic to the mesophytic type is a phenomenon called succession.

"The evaporation rates and the amount of soil moisture in the various communities both in Minnesota and Nebraska vary in general directly with the order of their occurrence in the succession, the community nearest the climax being the most mesophytic in both respects."

Pool, Weaver, and Jean in a second monograph present the results of a continuation and considerable extension of these studies in 1917 at the stations in the prairie and woodland near Lincoln, and also much additional material from a new series of stations near Peru, on the Missouri River. This latter paper also presents many experimental data bearing on the successional sequence of the various woodland types as are commonly developed about Peru. In addition to the analysis of the physical factors, the authors have added quantitative analyses of the vegetation. Charts of belt transects similar to strip surveys of the forester, showing the exact number, diameter, and position of every woody plant growing on the area are strikingly illuminative. In fact, many of the quantitative data are shown graphically in a very convincing style.

The author's conclusions are quoted from the second monograph as follows:

"This paper contributes data which still further substantiate the conclusions drawn from previous investigations that evaporation rates and soil moisture conditions in the various plant communities studied

vary in general directly with the order of the communities in succession, the communities nearest the climax being the most mesophytic in both respects.

"The prairie and woodlands in the vicinity of Lincoln are considerably more xerophytic than those in the neighborhood of Peru. This fact is strikingly revealed in a comparison of the ecological factor data from the two areas, and it is also strongly reflected in the composition of the plant communities in the two places, although the two areas are only about 60 miles apart. Available soil moisture was exhausted in the prairie station at various depths in the vicinity of Lincoln on eighteen different dates in 1917, from May to September, while the same condition was recorded for only four dates, late in July and August, in the prairie station at Peru.

"Ecological conditions are shown to change rapidly as the forest-prairie ecotone is traversed in Nebraska. Habitats rapidly become more xerophilous and many of the more mesophytic species drop out entirely between Peru and Lincoln. It is thus shown that the natural extension of our native woodlands is greatly hindered, possibly altogether prevented in so far as any significant permanent extension is concerned, by the increasing severity of natural environmental conditions as we move westward away from the woodland types of southeastern Nebraska.

"The high saturation deficit and the low soil moisture content (often reaching the non-available point) of the prairie sites in eastern Nebraska constitute barriers over which forest trees can scarcely pass. We probably have herein the most ready explanation as to why our natural Nebraska woodlands are confined to the moist slopes of rather narrow valleys, and also the most probable answer to the oft-repeated question as to the treelessness of the prairies in general.

"The common forest types or communities of the region about Peru in order of their place in succession are as follows, beginning with the most mesophytic: The linden-ironwood type, the red oak type, the black oak-hickory type, the bur oak-yellow oak type. A bur oak-yellow oak-black oak combination is also quite common. The common forest type near Lincoln is the bur oak-hickory type, often mixed with elm and black walnut."

These investigations add in no small way to the heretofore meagre knowledge as to the cause of the treelessness of the prairies and the sharp definition of the tension zone between the prairies and the adjoining woodlands. The studies also stand out in bold relief against a great many purely ecological researches in that they contain fundamental conclusions welcomed by forest investigators because they are directly applicable to forest problems. Anyone interested in the silvics of the central hardwood species and in the treelessness of the prairies would profit materially by a perusal of the original data presented in these monographs.

C. F. Korstian.

Timbers and Their Uses. A Handbook for Woodworkers, Merchants, and All Interested in the Conversion and Use of Timbers. By Wren Winn. London: George Routledge & Sons, Ltd. 1919. Pp. 333.

The subject matter of this book is treated in ten chapters under the following headings: (1) The uses of wood, (2) geographical distribution, (3) insect pests of timber, (4) fungoid pests of timber, (5) accidents during growth, (6) the world's timber resources, (7) manufactures, etc., (8) the structure and formation of wood, (9) seasoning of wood, and (10) timber testing. There are also 96 half-tones (4 to a page) showing, none too well, the appearance of selected woods.

A book of this kind covering so wide a field must, almost of necessity, be largely a compilation. The amount of available material is so great that the compiler, to be eminently successful, must exercise rare powers of discrimination in what to use and what to leave out. The reviewer has a decided feeling that the compiler of this book has not always chosen wisely and that his treatment of his subject matter is not always the best. The book contains little that is new, is not authoritative enough for a reference book, and much of the subject matter is not well enough classified and digested to serve the general reader's need.

Take for instance the opening chapter which devotes nearly 100 pages to the uses of woods. The arrangement is alphabetical throughout. This is not particularly objectionable so far as concerns the industries, but to enumerate a lot of woods with little or no consideration of their importance and relative merit is decidedly unsatisfactory. In most instances, too, it would have been well to treat the industries according to countries. Under the subject of handles the treatment leads the reader to infer that our important handlewood is Oregon crab apple; white ash is not mentioned. In the consideration of pulpwoods, paper birch, buckeye, and boxelder are accorded equal rank with spruce; balsam fir and the pines are omitted. Apparently our most important cross-tie woods are Nootka cypress, northern white cedar, cypress, hemlock, and tamarack; our oaks, pines, and chestnut are not mentioned. It would seem that we have no timber suitable for telegraph poles. The chapter on furniture omits white oak, cherry birch, black walnut, and cherry, and includes mesquite which is referred to as a softwood; mahogany is also omitted! The only American woods mentioned as suitable for flooring are blue ash and Oregon cedar. White oak, our premier tight-cooperage wood, is not considered under

cooperage, the only oak mentioned being the cow oak. Longleaf pine is considered of chief importance for medicine!

The chapter on geographical distribution comprises lists of common and botanical names of trees by continents. The African list is notable for omitting practically all the timbers of commerce. The North American list includes *Pyrus malus, Fagus sylvatica, Aesculus hippocastaneum, Prunus domestica, P. cersaum, Pyrus ocuparis,* and *Acer pseudo-platanus* but leaves out such native forest trees as black ash, white oak, sycamore, tupelo, shortleaf, loblolly and red pines, bigtree, and others too numerous to mention. His list of trees of South and Central America and the West Indies is fragmentary and contains many errors. To cite only a few examples, *Chloroxylon swietenia* is an East Indian tree, the lignum-vitae of commerce is *Guaiacum* spp. and not *Ixora ferrea*, and the identity of cocobola is well established.

In the chapter on the world's timber resources the compiler says: "We have derived most of the information on the subject from the reports of the Forestry Commission of Victoria, Australia." This roundabout second-hand method is not to be recommended. Some of the information is decidedly obsolete. To cite a single example: "The existing government reserves (of the U. S. A.) lie in eleven States and cover 10,719,000 acres." And this in a new book published in 1919!

The remaining chapters appear to be somewhat better but a very large part of the subject matter is in quotation marks. S. J. R.

Elements of Hydrology. By Adolph Meyer. John Wiley & Sons. 1916.

Primarily a text book for the engineer and student, Meyer's "Elements of Hydrology" contains much of interest to foresters interested in the streamflow phase of forest influences and is worth while from a general reading standpoint. The book treats of the source of water, its form and occurrence, and loss, the various forms of runoff and their causes, the measurement of streamflow and its use, and the storage of water. The chapters dealing with meteorology, evaporation, transpiration, and runoff are of most interest to a forester and the first section is a treatise in itself on meteorology.

In the introduction Meyer states: "Among the principal contraversial subjects of hydrology are those concerning the interrelationship of forests, reservoirs, drainage, and streamflow. The lay mind associates the removal of forests and the drainage of lands with destructive

floods, without reference to the cause of floods . . . or the great variation in flood-producing characteristics of different watersheds. No general deductions of universal applicability can be made. *Every stream is a problem in itself.* . . . Observations indicate that forests may both increase and decrease floods."

The author apparently believes that the effect of forests is more detrimental than beneficial in times of flood for the four references to the subject are to the effect that forests retarded the melting of snow until the late spring rains began. Their effect on low-water flow is also minimized in one short sentence "the inability of the same heavy forests to produce a good low-water flow in dry seasons is shown by the fact that the discharge . . . fell .05 cubic foot per second per square mile."

In considering the effect of forests on surface runoff, the author says: "Virgin forest with deep humus cover, though of rare occurrence, has considerable absorptive capacity."

Considerable use is made of the data in the old Forestry bulletin on forest influences in discussing the effect of forests on temperature, evaporation, and precipitation, but no use is made of the later works of the Forest Service on forest influences such as that of Pearson, Jaenecke, Griffin, or Zon, or the compilation of the Forestry Committee of the Fifth National Conservation Congress.

The figures, charts, and maps with which the work is illustrated aid greatly in understanding the text and the formulæ. There are quite a number of tables in the book, especially relating to precipitation which quite properly belong in an appendix as they amount to more than 40 pages and are used only as a reference. The addition of a bibliography would add considerably to the work, though references are scattered through the text in the form of footnotes. E. N. M.

Mikrographie des Holzes der auf Java vorkommenden Baumarten III. By Dr. H. H. Janssonius, unter Leitung von Dr. J. W. Moll. Leiden. E. J. Brill. 1918. Pp. 764.

This volume deals with the Javanese woods belonging to the Calycifloræ. Included under this classification are the Connaraceæ, the Leguminosæ, the Rosaceæ, the Saxifrageæ, the Hamamelideæ, the Rhizophoreæ, the Combretaceæ, the Myrtaceæ, the Melastomaceæ, the Lythrarieæ, the Samydaceæ, the Datisceæ, the Araliaceæ, and the Cornaceæ.

In the three volumes of this monumental work the woods of 45 families are described in minutest detail. The method of treatment for each family is as follows: A comprehensive bibliography; a statement as to the amount and source of the material studied; a resumé of the features as a whole, and then of the several individual elements of the woods of the family; keys to the different species. The woods are then taken up by genera and species, the literature cited, and the material and method of treatment and preparation given. This is followed by the micrography of the woods which is treated under two heads—"topography," and description of the elements. Under the first heading are discussed such features as heartwood and sapwood, rings of growth, general distribution of pores, wood parenchyma and fibers, and the appearance and size of the rays, "ripple marks," gum ducts, etc.

The wood elements are usually divided into four groups—namely, vessels, wood fibers, wood parenchyma cells, and ray cells. Other groups such as substitute fibers, intercellular canals, etc., are added when occasion demands. Exact measurements are recorded for all features. Cell contents and crystals are also noted and described.

To the student of woods, particularly of tropical woods, this and its companion volumes are almost indispensable. There are no other extensive works comparable to them. The fact that they are written in German should not detract much from their usefulness since only a limited specialized vocabulary is necessary for an understanding of the descriptive text. Such work as this has world-wide application and is by no means limited to the particular Javanese species described. And it may well serve as a basis and guide for much needed investigation of the woods of other countries, especially of the American Tropics.

S. J. R.

Textile Fibers and Cellulose in Brazil.[1] By M. Pio Corrêa, Naturalist of the Botanical Gardens at Rio de Janeiro.

This book is a compilation of monographs on the important fibrous plants of Brazil. The most important of these plants are Piteira gigantea (*Fourcroya gigantea*) and jute (*Corchorus capsularis*) which occupy much of the book. The volume starts with a history of the use of the fibrous plants since the Portuguese first came to Brazil.

[1] *Fibras texteis é cellulose.* Ministerio da Agricultura, Industria é Commercio. Rio de Janeiro, Imprensa Nacional, 1919. Pp. 276 + XIII. Figs. 70.

The Indians used these plants for bowstrings, for ornaments and the like, and especially for ropes. The colonists took up these uses, but with the development of cotton, the use of such fibers declined until now it is rare.

It is not realized, even approximately, what the culture of fibrous plants will mean to Brazil. It will mean conquest of the desert and a

mercio. Rio de Janeiro, Imprensa Nacional, 1919. Pp. 276+XIII. Figs. 70.

vastly increased public wealth. Under textile plants are understood those that give long fibers of any color or diameter, smooth or rough, and moisture resisting. From these fibers are made containers, tissues, and ropes. To these belong the Agave and other Amaryllidaceae like the giant Piteira.

The important Brazilian fiber plants are found in less than ten botanical families, among which are the Bromeliaceae, the Palmaceae, the Malvaceae, the Amaryllidaceae, and the Urticaceae, with a probable total of not many species. The author recommends, however, the study of certain species of Sterculiaceae, Thymeleaceae, Ulmaceae, and Tiliaceae as being possible sources of raw material for paper.

Some persons have tried the culture of exotic plants, among which is Phormium tenax, Agave, Ramie (*Boehmeria nivea*), all introduced in Brazil in recent decades and, by that same circumstance, of common occurrence especially as ornamental plants. Ramie has been studied as a forage plant. Agave has been extensively planted but the plantations are still of small size and further experiments are needed; it is generally used for rope.

Many species of the Amaryllidaceae are exported from Mexico under the trade name of "Sisal" which strictly speaking, is derived only from Agave Sisalana, chiefly exported from the port of Sisal in Yucatan.

Of them all the author prefers the giant piteira because it furnishes a longer and silkier fiber than does the Agave, and also is so flexible that it is easily woven. It is the best for rope making.

Regarding cellulose-producing plants, useful in paper making, Brazil possesses so many great trees and fibrous tissues that artificial planting is not necessary. These trees are so rich in cellulose that it constitutes 45 per cent of the dry weight of the wood. The land surface of Brazil which is suited to the cultivation of fibrous plants is incalculable. Such plants will grow on poor soils and on shifting sands where sugar cane, wheat, corn, and coffee can not be cultivated. In the near future, Brazil will be of great importance in the commerce in cellulose

(pulp and paper). The productive capacity of Europe, the United States, and of Canada is diminishing constantly in inverse ratio to the capacity for consumption. The United States and Canada will place restrictions on the devastation of their forests of pulp wood, and in Europe the war has increased the great demand for material from America, especially in the reconstruction of destroyed towns. Almost all the wood needed for reconstruction in Europe must come from America.

Regarding forest devastation in Brazil, there has been protests since colonial times, but under the Empire and the Republic this condemnation has been largely platonic. This almost criminal devastation was accelerated by the lack of foreign fuel during the war and resulted in the destruction of virgin forests fit for a better use than the funnels of locomotives.

The author predicts the increased export of ties to foreign countries from Brazil.

Another menace threatens Brazil—the erection of pulp and paper mills—which will accelerate the devastation of the forest and which, in the selection forests, will be particularly bad, since only one tree in ten is suitable for pulp. Hitherto the Brazilian paper mills have been chiefly confined to making wrapping paper—not book or newsprint.

The author speaks of the growing shortage of pulpwood in Canada and in the United States and the corresponding probable demand on Brazil and other South American countries.

Among the plants which are not natives of the forest but of great importance in pulp production are rice-straw and bagasse, the pulp of the sugar cane.

The author also speaks of the possible use of leaves for making pulp for paper. This involves maceration, scraping, washing, and bleaching, after which the pulp is ready. One thousand kilograms of leaves yield the following: 250 kilograms of pulp, 200 kilograms of pure charcoal, 30 kilograms of coal tar, 1 kilogram of pyroligneous acid, 600 grs. acetone.

The author recommends the founding of a laboratory of "vegetable technology" similar to the Forest Products Laboratory at Madison, Wis. The government which will give such a laboratory will confer an inestimable benefit on Brazil with regard to teaching the people the way to take care of their forest wealth, a possession, the value of which until now, has been almost totally overlooked. A. B. R.

North American Forest Research. Bulletin of the National Research Council, Vol. I, Part 4, No. 4, August, 1920. 300 pp.

This Bulletin is a summary of the investigative projects in Forestry and allied subjects which were being conducted in 1919-20 by National, State and provincial governments, schools of forestry, scientific schools, and private interests in Canada, Newfoundland, and the United States. The work is a compilation by the Committee on American Forest Research of the Society of American Foresters. It is a first attempt to present a complete outline of forest research on this continent.

The Bulletin contains brief outlines of 519 recognized and numbered projects. Owing to a combination of many sub-projects for different species especially in the forestation groups into a few large single projects, 272 sub-projects in addition might be distinguished. Most of them could justifiably claim recognition as full projects by comparison with some that have that status. Each project appears under the name and location of the organization or agency under whose auspices it is being carried on. A concise side heading gives its title, and there follows a brief description of its scope, status, results to date, probable future development and the names of the person or persons engaged on the project.

To those who are interested in the field covered by a particular agency, the grouping of projects by organizations responsible for them, will appeal. To those who are seeking references in a special line of work, and perhaps to the majority of the many who will have occasion to consult the Bulletin, it will be a matter for regret that the arrangement is not based upon a systematic classification of subjects, so that all related projects might be found together. A carefully compiled subject index which would show by number the projects relating to a given problem, environmental condition or tree species would be a welcome addition. The table of contents shows the agencies and the broad geographical distribution of the work, but helps little as a subject guide, since only under the U. S. Department of Agriculture, Forest Service, are there subheadings indicating the different lines of investigation.

Forest research in North America has hardly yet had time to make a reputation for itself. Even to those who have been most intimately connected with it, the amount of work being done will come as a distinct surprise. The number of organizations participating (36), the

variety of the subjects (54), the extent of geographical distribution, and the number of projects (519) are astonishingly large. Doubtless, too, there are projects which have not been included unknowingly or through failure of the responsible agencies to furnish the information. The wonder is that the omissions are not more numerous. Evidently there are experiments being carried on in private industrial research laboratories along some of the lines, such as paper and pulp, and derived products, in addition to those in this Bulletin mentioned only as part of the work of the Canadian and United States Government forest products laboratories. It is hardly conceivable, for instance, that the New York State Conservation Commission is doing no work which might be classed as forest research, as its non-appearance in the Bulletin would indicate.

An analysis of the agencies represented shows, the Dominion of Canada with 4 divisions, the United States Department of Agriculture with 3 bureaus, 15 State forestry departments, 14 universities, and 5 private organizations contributing. Geographically all the forest regions and most of the important types and tree species are being studied. The intensity and amount of research in different States varies greatly. Canada and Newfoundland have 72 projects, of which 15 are due to private initiative; the United States Government has 202, States and universities 240, and private agencies in the United States only 5.

The phases of forest research covered and the number of projects devoted to each are as follows: Studies of the identification and distribution of trees, 16; experiments in forestation covering the characteristics, production, vitality, extraction, and storage of tree seed, 10; nursery methods as to the amounts, time and methods of sowing, treatment of seed, fertilizing, shading, watering, protecting, transplanting and packing nursery stock, 28; time for field sowing and planting, most suitable species, classes of stock to use, and effect of cover, 48. Sub-projects add 23, 13, and 126 to the three forestation groups, respectively.

Six projects have been undertaken to determine the influence of a forest cover upon precipitation, the melting of snow, and upon streamflow and erosion.

The value and methods of establishing windbreaks are being demonstrated in two studies.

In forest management 18 experiments with 13 sub-projects are under way to determine the best methods of cutting in different types of mature timber; of securing natural reproduction, 22; the value and practicality of thinnings in immature stands, 14; and the methods of brush disposal which will reduce the fire hazard and permit the establishment of young growth at a reasonable cost, 6.

The management of farm woodlands is the subject of three projects. A single study of pruning may be mentioned here.

Forty-eight studies are being made in forest measurements, 13 on volume, 6 on yield, and 29 on growth.

Fourteen projects may be classed as studies of forest types or of forest ecology. Nineteen deal with as many individual tree species, their characteristics and life histories.

The protection of the forests includes 57 projects, of which fire has 13, fungus diseases 11, insects 30, and other factors 3.

Studies of the grasses and forage plants in the forests are leading to the proper use of this secondary forest resource for the production of cattle, sheep, horses, and goats. A total of 29 experiments are in progress to determine the number of stock the range will support, the best method of reseeding depleted range, of handling stock, of developing watering places and of eradicating poisonous plants. One organization lists seven projects in forest zoology which are only indirectly related to the general subject of forest research.

Well-equipped laboratories are investigating the structure, mechanical and physical properties of woods, including 43 projects; methods of kiln drying and of preserving forest products by the use of chemicals have 24 projects; the construction and uses of laminated wood products, 5 projects; suitable species and improved processes for the manufacture of wood pulp and paper, 9 projects; the preparation and utilization of the products of destructive distillation of the different woods, and the methods and species best adapted to the production of turpentine and rosin, 19 projects; and the prevention of depreciation and decay due to insects and fungi, 9 projects.

Economic and industrial investigations include in all 62 studies. Eleven are on the uses of various woods for vehicles, for railway cars, for shipbuilding, etc., as well as the uses to which given species of wood are best adapted. Logging and lumbering methods and costs and lumber grading are the subjects of 10 projects. The possibilities of reforesting logged-off lands, the classification of land, forest policy

and taxation, and surveys of forest resources are incompletely and locally covered in 38 projects. Three studies are listed in which statistics of production and prices of forest products are being compiled.

Comparisons of the amount of research being devoted to different parts of forest endeavor on the basis of number of projects are not entirely satisfactory owing to the wide variation in the comprehensiveness of the different projects as listed. Greater standardization in this respect will undoubtedly be noticeable when a revision of the Bulletin is made. On the present basis, however, such comparisons of the broad phases of forest research may be made which are interesting and sufficiently reliable to justify drawing conclusions. Silviculture proper leads with 131 projects, exclusive of forestation, which has 86 additional. Forest utilization is second with 109 projects. Economic and industrial investigations have 62; protection 57; grazing and forest zoology 36; ecological studies 22; and distribution and identification 16. On the whole the distribution of the research is surprisingly well balanced when it is considered that it has developed among so many agencies without any coordinating leadership. The bulk of the study is quite naturally being expended on the problems of which the solution is in demand and the application evident and immediate.

Within these large groups, certain lines of work may be found which do not appear to be receiving their share of study. Farm woodlands, which are going to play so important a part in supplying the hardwood of the future, are the subject of only 3 projects. The actual amount of study on the subject is undoubtedly larger than this figure indicates, but still it is smaller than its importance demands. Economic investigations, with 62 projects, are still in an embryonic stage of their development. The projects listed by different agencies indicate the variation in the interpretations of what should be included as research in forest economics. For example, forest taxation is the subject of only one listed study. Land classification and forest surveys are very incompletely represented and there is undoubtedly a large volume of work being done along these lines which has not been included in the Bulletin because it was not considered of research character by the organizations responsible for it.

The length of the text discussion of the projects frequently is not proportional to their importance but apparently depends somewhat upon the inclination of the agency which prepared them. Variations from a few lines to over a page may be found. This is not surprising

in a first attempt at so comprehensive a compilation. Improvement may be confidently expected in the next revision. The lack of errors in typography and substance show the care with which the Bulletin was edited and proof read. The printing and general appearance are exceptionally good.

North American Forest Research is a valuable contribution to forest literature, useful not only to forest investigators but to all foresters and to many others who are connected with the forest industries. As a pioneer in the field it meets a real need effectively. It will unquestionably attain its object as a "clearing house of information on current investigative projects" and as a "means of informing investigators of each other's work and in this way help indirectly to avoid duplication of effort and give the encouragement that must come from the knowledge that there are others who are working in the same field." In so doing, it will reflect deserved credit on the Research Committee of the Society of American Foresters which was responsible for its preparation.

J. K.

PERIODICAL LITERATURE

BOTANY AND ZOOLOGY

Late Retention of Foliage in the Fall of 1919

As late as December 1, 1919, many tree species still had all or some of their leaves. The pear (*Pirus communis*), Red thorn (*Crataegus monogyna*), the garden rose, blackberry (*Rubus cæsius*), and peach (*Prunus persica*) had shed only a little of their foliage. The explanation of this phenomena rests on a review of all the meteorological conditions through the year. The temperature, due to a late and cold spring, was such that the vegetative period was prolonged, in order to enable the trees to produce the normal amount of storage energy and material for the winter. A cool summer further held back the vegetative activity. Meagre precipitation in May, July and September had its influence in curtailing the vegetative energy. Heavy precipitation in October encouraged the growth to make up for delayed summer growth. At the beginning of November, the trees had not yet arrived at the condition which would allow a passing over into the period of vegetative rest. In other words, the formation of the layer of parenchymatous cells at the base of the petioles which enables the leaf to fall away easily from the stem had not been formed in many tree species. With the beginning of November came heavy snows and continued cold weather which interrupted growth and hindered the formation of the parenchymatous layer. The trees were forced into their rest period, the leaves gradually ceased their activities, and very slowly died and dropped off. Summing up, a combination of adverse conditions—a late spring, a cool summer, a wet October, and an early November frost—was responsible for the rather extraordinary retention of the foliage in the fall of 1919.

J. Roeser.

Pietsch, Albert. *Wie erklärt sich das lange Hängenbleiben der Blätter an einigen phanerogamen Holzgewächsen im Herbste 1919.* Naturwiss. Zeitzchr. Forst- u. Landwi. 18:150-155. 1920.

SOIL, WATER, AND CLIMATE

Forests and Streamflow

Since 1900 the Swiss forest experiment station has been studying the influence of a forest cover on streamflow in two neighboring and comparable watersheds, one of which was 97 per cent and the other 29 per cent forested. Actual measurements show that forest soils in good condition absorb the bulk of the precipitation, which later runs off subterraneously; while in soils not so protected there is an immediate surface run-off accompanied by erosion and gullying, particularly on steep, turfed slopes. This beneficial influence of the forest is due to the permeability and porosity of its soil rather than to the great hygroscopicity of the humus and moss cover, which if too abundant may actually, after becoming saturated, have the opposite effect and stimulate surface run-off. During periods of rapid snow melting both the peak of the flood and the total discharge were less from the well-forested than from the poorly forested watershed. The run-off from the former after heavy or torrential downpours was only a third to a half of that from the latter. After prolonged rains the influence of the forest depended on whether the soil was comparatively dry or saturated at the beginning of the wet spell. In any event, however, erosion is less on well forested watersheds, and the flood waters from them, having a lower velocity and carrying less detritus, do less damage. During periods of prolonged drought the stream from the well forested watershed never went dry, while that from the poorly forested one often did so for a month or two at a time. All of these differences would have been more marked if the well forested watershed had not had appreciably steeper slopes than the other, and if the latter had been completely deforested.

S. T. D.

Huffel, G. *Le mouvement forestier à l'etranger: station de recherches forestières suisse.* Rev. Eaux et Forêts. 58:249-254. 1920.

Chlorophyll Assimilation and Water Requirements of Scotch Pine

Dry wood contains about 50 per cent carbon and air about 0.3 per cent carbon dioxide. For a forest of Scotch pine to produce 5 cubic meters of wood per hectare per year, it is therefore necessary for the chlorophyll in the leaves to come into contact with 7,715,000 cubic meters of air. This means that during the 1,200 hours of insolation in the period of vegetative activity between May 1 and September 1, the leaves must absorb every second a volume of air equal to nearly one-fifth of their own volume; or, in other words, that the openings in the chlorophyll tissues must fill and empty themselves of air at least

every two seconds. The pine leaf is thus far from being an inert organ. Assuming that each cubic meter of air expired contains on the average 20 grams of water vapor, which is certainly a maximum, the leaves would transpire each year 151,000 kilograms of water per hectare. Assuming further that evaporation from the leaves and other parts of the tree is twice the transpiration, the total annual water requirement of the forest is approximately 500,000 kilograms per hectare. This is equivalent to a water blanket over the surface of the soil 5 centimeters in depth. In spite of so small a water requirement, Scotch pine forests sometimes fail to produce a normal amount of wood because they are in general relegated to soils which do not retain capillary water well, because the humus which they produce improves only slightly the physical properties of the soil, because the root hairs occupy a comparatively thin layer of soil, and because the tree itself has but little reserve capacity. While Scotch pine seldom dies of drought, a soil which is dessicated during the growing season may thus result in reduced wood production. Conditions may be considerably improved by underplanting open stands with such species as beech or hornbeam, which produce a heavy leaf litter. S. T. D.

Morel, C. *Activité de l'assimilation chlorophyllienne chez le pin sylvestre, quantité d'eau nécessaire à la végétation d'une forêt de cette essence.* Rev. Eaux et Forêts. 58:163-166. 1920.

Conversion of Coppice Into High Forest

The value of the high forest, long advocated by the leading French foresters as the forest *par excellence*, was conclusively demonstrated by the recent war, during which it was primarily the high forests under State ownership that supplied the enormous quantity and wide variety of forest products required by France and its allies. For both public and private owners the high forest is superior to coppice in the quantity, quality, and variety of its products, in its proportionately smaller cost of protection and greater production, and in its flexibility of management, which is particularly valuable in times of economic stress. The objection that it yields too low a rate of interest has lost much of its force in these days when timber prices are so high and most other investments so insecure. Some sacrifice of annual revenue is involved during the period of conversion, but this is purely temporary, can be minimized by proper handling, and really consists of an addition to the forest capital com-

parable to a savings bank investment. Cultural difficulties are more serious, but are due largely to the attempt to bring about the conversion through the establishment by natural reproduction of seedling stands with a regular distribution of age classes. The State forests of Bourse and of Ecouves prove that, at least in the oak and beech stands of western France, the establishment of satisfactory high forests from thrifty trees of sprout origin is not only comparatively easy from a cultural point of view, but can be effected at a considerable saving of time and money. The conversion can be brought about either by allowing the stand of coppice to keep right on growing, with occasional thinnings to prevent its becoming too dense; or by making a "conversion cutting" which would remove the bulk of the trees, leaving several hundred carefully selected reserves to the hectare, most of which would be of the same age as the main stand. The latter method has the advantage of yielding an immediate revenue and of affording the best possible growing conditions for the trees left. One area treated in this way which had to be prematurely clear cut 38 years later during the war yielded 4,000 francs per hectare, exclusive of previous thinnings, as against an estimated yield of 1,200 francs per hectare had the conversion not been undertaken. With suitable species, vigorous trees, and good soil, the method is applicable to private as well as to public forests. When conditions are unfavorable in these respects clear cutting and planting or underplanting with silver fir is usually necessary. Private owners, who will ordinarily make the "conversion cuttings" from five to ten years earlier than the State, will find it advantageous to leave a larger number of reserves, say 1,000 per hectare in a 23-year-old stand. It is usually advisable to remove old reserves already on the ground, not only because of the revenue to be derived from them but because their subsequent growth is likely to be unsatisfactory and to interfere with the best development of the rest of the stand. In selecting reserves to be retained, the species and general vigor of the trees are more important than their origin. The object of the method is not to obtain a stand of natural seedlings in some far off future, but to effect the immediate conversion of a coppice stand into high forest with a view to securing the maximum yield of timber. S. T. D.

Aubert, C.—G. *La conversion des taillis en futaie dans l'ouest de la France.* Rev. Eaux et Forêts. 58:124-132, 153-160, 189-194, 227-234. 1920.

SILVICULTURE, PROTECTION, AND EXTENSION

Forestry Based on Nature

Advocates getting away from theory and arbitrary rules and methods in forest management, with a closer adherence to natural laws and the phenomena of forest growth. Accurate prediction of growth for long periods is impossible, and the most carefully made theoretical working plans are always sooner or later upset by natural influences, such as windfall, drough, frost, insects, fires, failure of seed years, and the like. The system proposed has been tried out since 1900 on a 5,000-hectare fir and beech forest in Alsace. An essential feature is the 5-year cutting cycle, by which every part of the forest is gone over every 5 years. This makes possible the removal of diseased, suppressed, and ripe trees and groups of trees at the most suitable time, and is especially favorable to growth of the remaining trees and to natural reproduction. Another feature is the maintenance of a continuous forest cover, unbroken by clearings except where they result from accident. The frequent cuttings insure light and ventilation. Instead of extensive, pure, even-aged stands, the age classes are mixed together in small groups, as usually occurs in nature, so that the forest takes on the appearance of a selection forest. Because of the long periods required for trees to mature, soil exhaustion can not be prevented by rotation of crops as easily as with other crops. The same result can be obtained, however, by using mixed stands, composed of species with different soil requirements. The beech is especially valuable for improving soil fertility, as well as for favoring better development of the associated conifers, and its proportion in the stand can be varied from time to time as conditions require. Other species, such as oak, maple, ash, elm, birch, alder, and Scotch pine, may also be used with beech, provided they are given several years start and are planted in large enough groups so that they will not be shaded out. For purposes of management forests should be divided into compartments of an average size of not more than 10 hectares. At the 5-year intervals, cutting is done, not in accordance with a predetermined working plan, but according to the actual silvicultural needs of each individual compartment, and also according to current market conditions. In some, no cutting at all may be done; others may be cut very heavily. The usual method of determining the annual cut is very complicated, involves much manipulation of figures, and can not be accurate. The average increment and the allowable cut

can be better and more simply determined from a series of small permanent sample plots on the different sites, to be cut over regularly with the rest of the stand. Other advantages of the method described are the more intensive and careful handling of the forest, and the great simplicity and flexibility of the working plans. W. N. S.

Seybold, Karl. *Die Forstwirtschaft der Tatsachen (natürlicher Hochwaldbetrieb)*. Forstwiss. Centralbl. 41:405-426. 1919.

Strip Removal Cuttings

With most silvicultural systems that depend upon natural reproduction, considerable damage is done to young growth by the removal of the older trees. This is particularly true where, as in most cases, successive cuttings proceed *away* from roads and *upward* on slopes. Under the system here proposed cutting begins half way between main roads, in level country, and proceeds *toward* the roads, so that logs are not dragged over young growth. On slopes, cutting strips lie up and down the slope. The system involves a preparatory stage, with frequent light thinnings in the upper crown class over the whole area until reproduction is established and two or three years old. This preliminary stage is practically the same in all methods relying on natural reproduction. The method described differs from the strip selection system (Blendersaumschlag) in that the resulting new stand in each compartment is even-aged or at most divided into a few even-aged groups. It differs from the shelterwood system in that the removal of the old stand is not carried on uniformly over the whole area but is done unevenly in strips or wedge-shaped patches. It is claimed that damage both from windfall and from logging is very small, while logging costs are kept down to a minimum. W. N. S.

Eberhard. *Was will der Abrücksaumschlag (Keilsaumbetrieb)?* Forstwiss. Centralbl. 41:441-448. 1919.

The Weymouth Pine

Suggests caution in planting white pine on a large scale in Germany, because it is susceptible to blister rust (*Peridermium strobi*), it has a decided tendency to develop many branches which hang on even after they die, and so yields inferior lumber; and it is attacked by the pine barklouse (*Chermes strobi*), which retards growth and even kills the trees or so weakens them that they are attacked by

the fungus *Agaricus melleus.* Neither does this tree, as has been supposed by some, thrive on all kinds of sites, but requires a fair amount of moisture and prefers good soil, upon which native species will generally yield better returns. Some of the failures of white pine plantations are due to carelessness in selecting the sites. The wood is not of particularly high quality; even attempts of the Diamond Match Company in Germany to use it for match manufacture failed, because it did not split well and was too brittle. Planting in pure stands is not recommended, but on account of its good silvical qualities it is a good species to plant in mixed stands with spruce, beech, and Scotch pine, especially to fill openings which may develop in such stands after they are established. The name "silk fir" (*Seidenföhre*) has been used in Baden and the Palatinate to avoid the English "Weymouth pine." "White pine" conflicts with *Pinus silvestris*, called white pine in Austria to distinguish it from the black pine. Baltz suggests "Strobe."

W. N. S.

Baltz. *Die Weymouthskiefer (Pinus strobus).* Forstwiss. Centralbl. 41: 302-307. 1919.

Douglas Fir in France

Douglas fir (the "green" variety) is less exacting in its soil requirements than indicated by Hubault in a previous issue of the Revue; has no aversion to calcareous soils; does not suffer from late spring frosts; and will stand neither overhead shade nor the competition of herbaceous vegetation. It does best in western France, but thrives in many other parts of the country. Few species, and certainly no native one, can rival it in rate of growth. It is reproduced more easily than Scotch pine, forms denser stands, and produces a superior wood. The State should try it out in the reforestation of the areas devastated by the war.

S. T. D.

Hickel. *Le Douglas en France.* Rev. Eaux et Forêts. 58:5-8. 1920.

Scotch Pine Seed

Scotch pine seed collected from trees of several ages was left exposed to the heat of an unused hothouse for one summer. It was sown the following spring and gave the following germination results: Seed from 15-year-old trees, 87 per cent; 30-year-old trees, 50 per cent; 45-year-old trees, 30 per cent; 60-year-old trees, 15

per cent; 110 year old trees, failure. These results agree with those discussed in another article in the January, 1910, Quarterly JOURNAL OF FORESTRY. C. R. T.

Green, Frederick J. *Germinative capacity of pine seed.* Quart. Jour. Forest. 14:140-141. 1920.

MENSURATION, FINANCE, AND MANAGEMENT

Breast High and Stump Diameters

Measurements of a large number of stumps of oak and beech in the forests of Gers, Hautes and Basses Pyrénées showed that the sum of the largest and smallest stump diameters, measured at the surface of the ground, was approximately equal to the sum of the circumferences of the same trees measured at breast height (1^m 30). In other words, the average diameter at breast height in the case of these two species was equal to 63 per cent of the mean diameter of the stump at the surface of the ground. S. T. D.

de la Hamelinaye, H. *Rapport du diamètre à 1^m 30 au diamètre de la souche.* Rev. Eaux et Forets. 58:133-135. 1920.

UTILIZATION, MARKET, AND TECHNOLOGY

Drying Lumber and the Ascent of Moisture

An analogy is suggested between the operation of drying lumber and the ascent of moisture in the living tree. In order to explain the action of the condenser in removing moisture from the air (a very well understood principle) a new theory is proposed for the ascent of the sap in the tree, and the condenser drying is compared thereto. From the point of view of the problem of the ascent of the sap the hypothesis proposed has considerable merit and is worthy of study. The idea, although undoubtedly original to Mr. Stone, is not altogether new. In short, it is that the moisture passes upward through the vessels or "fairways" in the form of vapor, and condenses upon the walls and is thence absorbed into the walls of the cells. "The bulk of the condensation will take place at night when the radiation of the heat from the branches lowers the temperature much below that of the trunk; a reserve of water will thus be formed that will suffice for the following day. The flow of

the sap from the sugar maple when tapped is greater during the night. It flows from the upper edge of the wound, showing that it does not come from the root but from the top." The transfer of soil salts from the roots to the leaves is assumed to take place by simple diffusion through the moisture contained in the cell walls.

In regard to the drying of timber Mr. Stone suggests a refrigerating condensing process, thus supplying dry, cool air to the wood. In practice such a process would not produce good drying nor be economical. While his idea of the explanation of the physical phenomenon of transfusion of the moisture through the stick of wood is good, his assumption that the same principle holds good for drying wood in the air, is wrong on account of many other factors which come in to modify the action.

The hypothesis of the ascent of sap seems so well taken and well supported by facts that I might venture to add a few comments of my own to this review. Several years ago I had shown experimentally that moisture transfuses through wood from the hot toward the colder surface, and I explained this action on the theory of successive evaporation and recondensation within the cell lumina. In the *absence* of air a very slight difference in temperature will cause this action to proceed rapidly; in fact, as fast as the transference of heat can take place. The presence of air would greatly retard it. In the living tree, there is probably little air in the vessels of the sapwood during rapid growth. The hypothesis seems so plausible that it might indeed be carried a step further, and the function of the peculiar valve-like bordered pits of the tracheids, a long time hidden problem, be accounted for. Suppose that the membranes of these marvelous structures allow the water-vapor to pass freely through when the tori are centrally located (which is certainly the case). If the temperature of a series of tracheids be now sufficiently cooler at night than contiguous ones below, as to cause them to become filled with water through condensation, the pressure of this water column might become sufficient to close the valves of the bordered pits and thus prevent the water from escaping downward when the temperature changes, as in the following day time for instance. Thus a means would be provided for accumulating water, through small changes in temperature, passing upward by vaporization and being prevented from flowing downward by its own weight and the valve action of the bordered pits.

H. D. TIEMANN.

Stone's theory assumes the passage of water through the cell walls where it has been condensed from vapor. Nearly 40 years ago Elfving demonstrated that quantities of water sufficient to meet the requirements of transpiration could not pass through the cell walls. In more recent years the theory has been re-examined and subjected to experimental tests by numerous investigators, especially by Dixon and Joly (Annals of Botany, 1895, ix, p. 403, and Dixon on *Transpiration and the Ascent of Sap in Plants*, 1914, MacMillan Company), and so far as I know they practically all conclude that while some water does pass upward through the walls, the amount is not sufficient to prevent the wilting of leaves when the plants are subjected to the transpiration conditions of an ordinary laboratory.

The statement of Stone that "the flow of sap from the sugar maple when tapped is greater during the night," does not correspond with the experimental evidence on the subject. (See Bulletin 103, Vermont Agricultural Experiment Station, p. 137.)

In regard to the reviewers' statement that the presence of air in the tracheæ would greatly retard the passage of water by successive evaporation and condensation, I may say that the experimental evidence of its absence or presence is unsatisfactory. I think the general opinion, however, is that air (or gas) is present in variable quantities dependent upon the physiological condition of the tree in all tracheæ more than one year old and from the fact that nature connects up the newly made water channels of the year with those of the previous years, it is thought that the former do not in themselves transfer enough water to meet the requirements.

The membrane of the bordered pit has bothered many plant physiologists. It probably is not as accommodating as many would like to have it. Since it is not heavily lignified, water passes through it with much greater ease than through a wall. A moderate flow of water does not deflect it from its median position. In fact, some investigators, like Pappenheim, for example, say that the normal transpiration current does not possess sufficient velocity to force it over to a lateral position.

Finally, Dixon in his book on *Transpiration and the Ascent of Sap in Plants*, p. 43, states the vapor pressure theory very clearly. He subjected it to experimental conditions and then stated his conclusion as follows: "It appears that the movement upwards of water in the form of vapor through the lumina is insignificant."

I hope the above will not discourage Dr. Tiemann from investigating

the subject. Modern research is making us change our minds on many things that we had been led to believe were definitely established.

C. D. HOWE.

Herbert Stone. *The Ascent of the Sap and the Drying of Timber.* Quart. Jour. For., Oct., 1918, pp. 261-266.

STATISTICS AND HISTORY

Wood Production After the War

A recent report (reprinted in full) by M. Dabat, Director-General of Waters and Forests, emphasizes the urgent need for the increased production of saw timber. In order to relieve the present situation as quickly as possible he suggests the development of transportation facilities in the less accessible forests and the utilization of the enormous forest resources of the French colonies. The latter involves the education of consumers in regard to the technical qualities of colonial woods, standardization of nomenclature, and revision of the tariff so that the more common colonial woods will not be taxed at the same rate as the more precious ones. Measures which will not yield tangible results for some time include lengthening the rotation of coppice stands; maintaining a larger number of reserves in coppice under standards; converting coppice under standards into high forest; converting hardwood coppice of poor yield into coniferous stands, particularly in mountainous regions and on poor soils; reforestation of unproductive lands; and the purchase of forests by the State, communities, and public service corporations with a view to managing them for the production of saw timber. M. Dabat also urges that the State assist private owners in the handling of their forests; that a service be created for the study of forest statistics and forest economics, as well as of the technical qualities and uses of native, colonial, and foreign woods; and that forest experiment stations be organized under the direction of the National School of Waters and Forests. Nothing but commendation can be given to the program proposed by M. Dabat. But to carry out such a program and to practice the intensive silviculture which it contemplates, requires men as well as good intentions. It will therefore remain merely a dead letter if the administration persists in its present tendency to decrease, rather than to increase, the forest personnel.

S. T. D.

Anonymous. *Production de bois après guerre.* Bull. Trimest. Soc. Forestière Franche-Comté et Belfort. 13:162-165. 1920.

Forest Statistics for Alsace-Lorraine

The director general of forests at Strassburg has published a 98-page volume of statistical information regarding the forests of Alsace-Lorraine. Among other things this shows that the forest area of the two provinces on April 1, 1916, was 440,594 hectares, of which 31 per cent was owned by the State, 4 per cent was undivided between the State and a commune, 46 per cent was in the hands of communes and public institutions, and 19 per cent was held by private owners. Since 1871 the forest area has decreased 5,673 hectares, or slightly more than 1 per cent. During the same period gross prices of timber have increased 34 per cent and of firewood 47 per cent, but there has been a constant tendency to include smaller and smaller material in the former class. The annual yield of the forests owned by the State and of those undivided between the State and a commune is estimated at 551,422 cubic meters of large timber, including both intermediate and final products. During the war, however, the actual cut and other matters of administration were decidedly abnormal. S. T. D.

Huffel, G. *Statistique des forêts de l'Alsace-Lorraine.* Rev. Eaux et Forêts. 58:185-188. 1920.

Economic Crisis in Switzerland

The economic crisis in Switzerland caused by the war still continues, with high prices for both timber and firewood and comparatively little building activity. While forest devastation has not been general, it is necessary to use every means to make the forests more productive. By more intensive management, made possible largely by decreasing the area under the supervision of each forest officer, it should be feasible to increase the annual production of the public forests from 2.7 to 4.4 million cubic meters, thus making the country independent of wood imports aside from exotic timbers. The recently created "central forest office," with headquarters at Soleure, should prove effective in supplementing other activities to awaken public interest in and support of the practice of better forestry. S. T. D.

Barbey, A. *Chronique suisse.* Rev. Eaux et Forêts. 58:136-138. 1920.

POLITICS, EDUCATION, AND LEGISLATION

Two Schools of Forest Policy

In a recent article in the *Revue*, M. Raux advocated the public control of private cuttings. Under pretext of conserving the public interest he would destroy, without compensation and at the expense of the owner, the very essence of private property, namely, the right of the owner to dispose of his forest as he sees fit. The days when kings exercised complete control over the property of their subjects are past. Today the citizen in France is regarded as capable of managing his own affairs. Whenever the public interest demands the placing of certain restrictions on the right of property, these restrictions must be accompanied by just compensation. Such control as M. Raux suggests would be vigorously opposed by private owners. Many of these already manage their forest lands as well as the State, and the great majority are ready to follow voluntarily the example set by the public forests. Private owners are not responsible for their failure so far to take advantage of the law of July 2, 1913, permitting them to place their lands under the technical direction of the State. The regulations recently issued providing for the execution of this law will make it possible for all who care to do so to take advantage of it. The unfortunate lowering in 1906 of the penalties for forest trespasses was primarily the work of a politician of the "authoritative" school, and cannot be charged to the advocates of a "liberal" forest policy. To withdraw the control over fishing bestowed upon the Administration of Waters and Forests in 1896, as proposed by M. Raux in order to make available a larger personnel for the carrying into effect of State control of private lands, would be a step in the wrong direction. S. T. D.

Guyot, Ch. *Deux devises de politique forestière*. Rev. Eaux et Forêts. 58: 25-28. 1920.

MISCELLANEOUS

Purification of Waste Waters

In spite of its many lakes, ponds, and streams France is now far from self-supporting in the production of fresh-water fish. A serious obstacle to the adequate development of fish culture is the pollution of streams and lakes by the waste water from factories and mills. The courts have held that manufacturers are required by

law to take whatever measures may be necessary for the purification of their waste water, irrespective of the difficulty that may be involved in doing so. This law should be enforced, and in the industrial reconstruction of the devastated districts special precautions should be taken to see that the new factories which must be built are properly equipped to care for their waste waters. This is desirable from every point of view and would greatly facilitate the much-needed development of fish culture. S. T. D.

Demorlaine, J. *La reconstitution industrielle et les déversements résiduaires.* Rev. Eaux et Forêts. 58:100-102. 1920.

The Problem of Sewage Disposal

The problem of sewage disposal has been solved at Strassburg by the construction of stagnant ponds in which the organic material is assimilated by protozoaires, worms, crustaceaus, insect larvae, molluscs, etc., and these in turn are eaten by carp and other fish. The latter are entirely safe for human consumption and have no disagreeable taste. One hectare of pond is sufficient to dispose of the sewage from 2,000 to 3,000 people (nearly ten times as many as can be cared for by filtering the waste water in settling basins), and at the same time to support an abundant population of fish. This method suggests to foresters the possibility of introducing organic matter into the many ponds and streams found in the plains where communal forests cover more than 20 per cent of the land area, and of using these for the breeding of carp and other Cyprinides, which would form an important addition to the food supply of the country.

S. T. D.

Jolyet, A. *Les bassins d'épuration du Wacwen à Strasbourg et L'élevage des Cyprinides.* Rev. Eaux et Forêts. 58:195-202. 1920.

SOCIETY AFFAIRS

A Challenge

Members of the Society:

The "Capper Report" has stated that the forests in this country are growing only one-fourth as fast as they are being cut. Are you satisfied as to the accuracy of this statement? Are you content to remain in ignorance of the potential growth on lands already forested, if placed under management; on cut-over lands; on lands which may and should be planted? If you are not content, you must *do* something. If you have a grain of natural curiosity in your make-up, a grain of professional ambition to possess some *facts* on the subject you are dealing with every day, you are going to check up this statement. You are going to equip yourself to make at least an intelligent estimate of the possible productive capacity of the forests you are most familiar with.

A year or more ago a man prominent in the Society of American Foresters accused the lumbermen of this country of being stupid and blundering in the handling of their business. He stirred up a hornets' nest, and rightly, I think. What would you think, how would you feel, if some prominent lumberman should publish the assertion that the foresters in this country were generally lacking in professional ambition, ignorant of their own subject, and largely failing to carry out the promises, direct or implied, that were contained in the forestry program of 10 or 15 years ago? Well, do you think that Mr. Lumberman would be so far wrong at that? Are you sure you are not a swivel-chair lizard? Are you sure you do not write pretentiously on subjects of which you know little, on subjects to which you have not added any really important information? In other words, are you sure *you know your forest*, and not merely the abstract *forestry* you have picked up somewhere? In looking after the big things, haven't you somewhat lost contact with the little details which are the heart and soul of forestry?

I don't intend to be abusive. But I do want *you* to ask yourselves these questions: I want you to ask and answer frankly whether pro-

fessional foresters in America have not fallen into a lethargy, which they should shake off for their own good; which they must shake off if the new national program is not to become a farce, merely a pork-barrel proposition!

The National Research Council is a co-ordinating institution between science and industry. It has a Forestry Committee in the Division of Biology and Agriculture. Some of the leading foresters in the country, on this Committee, and with the backing of the larger Council, are seeking to discover the most important needs of forestry; seeking to fill gaps which can not be filled or for some reason have not been filled by the Forest Service and other agencies working independently. As I have said, the general purpose of the Council is to co-ordinate, not to undertake, research. Yet in some instances it will fall upon the Council to correlate results and fill in the gaps before some of the big problems can be solved.

An example is the project which has been approved by the Council for the study of "Potential forest growth under management, with special reference to the southern pine region." This project is semi-local, there are not a great many foresters in the South, but those that are in a position to help will be expected to help. The Council and the Forestry Committee can not accomplish anything unless every forester is willing to pitch in and obtain the *facts*.

As time goes on, the Committee will doubtless suggest extensions of this study, and other projects, which will give every member of the Society a chance to *do* something. Buckle on your compass, whet your axe, polish your lense, and be ready to act. But, in the meantime, give the Committee your suggestions, on an extension of the study mentioned, or on any other broad study which you think ought to be undertaken by foresters as a whole. This Committee is brainy, it may even be possessed of psychic powers, but it *might* fail to read your thoughts at long range if you are too modest to express them. Write, right now, to Mr. Zon, Chairman of this Committee, at Washington.

In brief, foresters, what the Committee wants is full co-operation from the membership of the Society, not only in getting the information which an expanded forestry program requires, but in deciding what are the urgent needs. Be awake! Don't let some outsider try to tell you what the problems of your region are! Zon pretends to hear the voice of the people. Make him prove it! C. G. BATES.

NOTES

Sugar Secretion from Conifers

Since the secretion of sugars from conifers is attracting some attention, the substance of the enclosed letter may be of sufficient interest to the readers of the Journal:

J. H. Maiden, Esq.,
Director Botanical Garden,
Sydney, New South Wales, Australia.

Dear Sir:

In connection with the interesting observation recorded by you in Bulletin 14, Forestry Commission, New South Wales, on the occurrence of a sugar secretion from the branches of the white cypress pines, I beg to call your attention to a similar phenomena observed on *Pseudotsuga taxifolia* in British Columbia, by Prof. Davidson of the University of B. C., and recorded in *The Canadian Field Naturalist*, Vol. 33, p. 6, 1919. This Douglas fir sugar or "manna" has attracted much attention in America as it is found to contain a valuable Melezitose much sought after in the chemical trade. (See *Journal of the American Chemical Society*, Vol. XL, No. 9, 1918.) I have observed the presence of a sugar secretion on the needles of the Douglas fir in Idaho and Montana, but it is of rare occurence, and is not apt to be found in sufficient quantities to be of any commercial importance.

Very truly yours,

James R. Weir.

New Zealand Reforestation

The New Zealand Parliament has appropriated \$691,257 to be devoted to the development of reforestation and to look after the existing Government forests. It is proposed to utilize at least 2,000,000 acres for reforestation at as early a period as possible, and this allowance is to assist in getting some of the land in shape.

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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

FIBER STUDIES OF PHILIPPINE DIPTEROCARPS[1]

By LUIS J. REYES

The Dipterocarpaceæ is preeminently the most important timber producing family in the whole Indo-Malayan region, an area including the greater part of India, Burma, Siam, Cochin-China, the Malay Peninsula, Sumatra, Java, Borneo, the Philippines, and the Indo-Malayan Archipelago as far south as New Guinea. As Whitford[2] has pointed out, the dipterocarp family ranks second to none in the Philippines as a source of timber and is fully as important in this respect as the *Pinaceae* and *Fagaceae* in the United States. He estimates that fully 75 per cent of the forest area is occupied by various representatives of the family and that 95 per cent of the volume of standing timber is dipterocarp. Nine genera[3] and 70 species have been described from the Philippine Archipelago but this number promises to be appreciably increased as the flora of the islands becomes better known. The dipterocarp family is, and will continue to be, the most important source of timber in the Philippine Islands for many years to come.

As is to be expected in a dominant family of such wide distribution and multiplicity of forms, dipterocarp woods exhibit a wide range of variation in color, durability, and strength and lend themselves to multifarious uses. The soft, light-colored woods, products of the genera *Pentacme*, *Parashorea*, and *Shorea* furnish a large percentage of the cheap construction timber in the Islands. The red *Shoreas*, such as *S. polysperma*, *S. negrosensis*, and other red dipterocarps are used for

[1] Contribution from the Department of Wood Technology, The New York State College of Forestry.

[2] Whitford, H. N. "The Composition and Volume of Dipterocarp Forests in the Philippines." Philippine Jour. of Science, Vol. IV, No. 6, Sec. C, Dec., 1909.

[3] Foxworthy, F. W. "The Philippine Dipterocarpaceae," Philippine Jour. of Science, Vol. XIII, No. 3. May, 1918. See also Vol. VI, No. 4, Sept., 1911.

high grade furniture and cabinet work.[4] Varous species numbered among which are *Hopea plagata, H. ovalifolia, Balanocarpus cagayanensis, Isoptera borneensis,* and certain forms of *Vatica* produce strong and durable structural timbers and are employed extensively in the Islands, under conditions requiring strength and durability. With the continued exploitation of Philippine forests and the increasing cost and scarcity of timber in the north temperate zone, new uses for Philippine dipterocarps are coming to the attention of the public. The present fiber study was undertaken with the hope that it might contribute to our knowledge of the suitability of Philippine dipterocarps for the manufacture of paper.

The first serious attempt to establish a local paper industry was made by the Philippine legislature in 1917, when a law [5] was enacted guaranteeing 4 per cent interest for three or six years on the initial investment. It was recognized at that time that there were obstacles which must be surmounted before the industry could be placed on a paying basis. Philippine forests do not offer conditions particularly favorable for harvesting the raw fiber since many tree species abound and pure stands are unknown. Small areas yield many woods which differ widely in density, color, and mechanical properties and the present study would indicate that only certain of these are suitable for pulp manufacture.

The problem becomes the more complex when we consider the lack of adequate water facilities in getting the logs to the mills. In the Philippines these obstacles are well nigh insurmountable and as the industry develops in the Islands raw fibers from other sources will undoubtedly be utilized in the manufacture of paper. But, as Brown and Fischer [6] have pointed out, considerable pulp material can profitably be obtained as by-products of logging and milling operations. It follows that this waste will be mostly of dipterocarp origin, since all the large sawmills in the Islands are operating on this type of forest.

In the selection of material I have been especially fortunate in obtaining authentic wood specimens from the extensive collections of the Philippine Bureau of Forestry. The majority of the samples em-

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[4] The wood of *Shorea polysperma* is marketed under the trade name of "Philippine mahogany" and has been employed successfully in the manufacture of airplane propellers.

[5] See Act No. 911, Philippine legislature, passed in 1917.

[6] Brown, W. H., and Fisher, A. F. "Philippine Forest Products as Source of Paper Pulp." Bull. No. 16, 1918, Bur. of Forestry, Manila, P. I.

ployed in this study were topotypes, while a few are type specimens, preserved with botanical material in the Government herbarium at the Bureau of Science in Manila. These were collected mainly from trees 30 centimeters or more diameter and came from different parts of the Archipelago. It is generally conceded that the anatomical structure of wood and consequently its properties are affected by, and vary with, topography and climate and such was found to be the case in *Shorea polysperma* and certain species of *Dipterocarpus*. Wood of *Shorea polysperma* from western Luzon, where rainfall is distributed unevenly throughout the year and growth conditions are subject to fluctuations, presents a striking contrast to samples of this species coming from the East and South, in regions where the annual rainfall is more evenly distributed. The woods are darker colored, denser, and less homogeneous in contrast to those from regions where the growth approaches the optimum. The difference is so striking that it is possible in many instances to determine the areal origin of a specimen by a superficial examination of the wood.

In macerating the woods preparatory to fiber examination Schültz's solution was used. This consisted in subjecting shreds of woody tissue measuring 2 to 3 mm. in diameter and 12 mm. in length to strong commercial nitric acid in the presence of a few crystals of potassium chlorate. Maceration is permitted to proceed at a temperature ranging from 35 degrees to 40 degrees C. for about 30 hours. The liquor eventually renders the shreds almost colorless. The acid is then poured off and the material thoroughly washed in several changes of water, care being taken to rinse off all loose fragments. The decolorized shreds are then placed in test tubes which are about half filled with water and the mixture thoroughly shaken. Sufficient fibrous material for purposes of study is isolated in this way.

Prior to the study the fibers were stained with a dilute solution of methyline blue and subsequently transferred to microscopic slides. It was found that the ordinary blue ink such as is used in fountain pens offers a satisfactory, temporary stain in place of the more lasting methyline blue.

Measurements were made of all fusiform non-septate fibers, which in the dipterocarp family consist almost wholly of libriform fibers and tracheids. The tracheids constitute but a small percentage of the fibrous material, and occur in immediate proximity to the vessels. In contrast to libriform fibers they are abundantly pitted, shorter, propor-

TABLE I.—*Fiber Lengths and Widths of Thirty-Three Species of Philippine Dipterocarps.*

Species	Length in mm. Max.	Length in mm. Ave.	Length in mm. Min.	Width in mm. Max.	Width in mm. Ave.	Width in mm. Min.	Remarks
1. Anisoptera curtisii Dyer	2.48	**1.27**	.57	.034	**.026**	.017	Vessels minute; wood comparatively hard.
2. Anisoptera mindanaensis Foxw.	2.67	**1.93**	1.29	.040	**.028**	.017	Vessels large; wooden medium hard.
3. Aniseptera thurifera (Blco.) Bl.	2.69	**2.05**	.91	.033	**.023**	.016	
4. Aniseptera thurifera (Blco.) Bl.	2.57	**1.95**	1.16	.033	**.024**	.017	Vessels largest of the three specimens.
5. Aniseptera thurifera (Blco.) Bl.	2.48	**1.60**	.92	.029	**.022**	.015	Vessels smallest of the three specimens.
6. Balanocarpus cagayanensis Foxw.	1.86	**1.42**	.90	.038	**.028**	.021	Sample from tree about 30 cm. in diam.
7. Balanocarpus cagayanensis Foxw.	1.80	**1.34**	.85	.026	**.019**	.012	Sample from tree about 50 cm. in diam., typical specimen.
8. Dipterocarpus affinis Brandis	2.34	**1.77**	.67	.034	**.023**	.017	Tree about 50 cm. in diameter, not typical of commercial product.
9. Dipterocarpus cuneatus Foxw.	2.39	**1.58**	.74	.034	**.027**	.017	Specimen typical of species.
10. Dip'erocarpus grandiflorus Blco.	2.68	**1.98**	.54	.031	**.025**	.017	Fast grown tree wood soft; pores small.
11. Dipterocarpus grandiflorus Blco.	2.30	**1.66**	.83	.031	**.026**	.017	Grain curly; wood dark-colored.
12. Dipterocarpus grandiflorus Blco.	1.86	**1.42**	.91	.038	**.028**	.021	Grain crossed, otherwise typ. specimen.
13. Dipterocarpus perturbinatus Foxw.	2.43	**1.80**	.81	.034	**.026**	.017	Wood hard; vessels small.
14. Dipterocarpus pilosus Roxb.	2.33	**1.73**	.92	.034	**.026**	.019	Vessels almost the same as (15); wood softer.
15. Dipterocarpus pilosus Roxb.	2.54	**1.51**	.96	.031	**.027**	.021	
16. Dipterocarpus speciosus Brandis.	2.56	**1.79**	.78	.034	**.027**	.017	Specimen from immature tree.
17. Dipterocarpus vernicifluus Blco.	2.61	**1.88**	1.36	.034	**.030**	.024	Vessel larger than (18); density practically the same.
18. Dipterocarpus vernicifluus Blco.	2.65	**1.71**	.78	.031	**.023**	.017	
19. Hopea acuminata Merr.	1.97	**1.38**	.65	.024	**.019**	.012	Vessels larger; wood soften than in (20); both samples typ. of the species.
20. Hopea acuminata Merr.	1.52	**1.21**	.74	.024	**.018**	.012	
21. Hopea mindanaensis Foxw.	2.23	**1.56**	.95	.024	**.019**	.010	Specimen typical of the species.
22. Hopea ovalifolia Boerl.	1.91	**1.48**	.79	.024	**.018**	.014	
23. Hopea philippinensis Dyer	1.91	**1.36**	.91	.021	**.017**	.012	Specimen typical of the species.
24. Hopea philippinensis Dyer	2.00	**1.22**	.78	.024	**.019**	.014	
25. Hopea pierrei Hance	2.04	**1.38**	1.04	.026	**.029**	.014	Specimen typical of the species.
26. Hopea pierrei Hance	1.78	**1.36**	.74	.024	**.019**	.014	
27. Hopea plagata Vidal	1.82	**1.41**	.82	.022	**.018**	.014	Wood softer than (28), which is typical of the species.
28. Hopea plagata Vidal	1.65	**1.30**	.65	.021	**.015**	.010	

29. Parashorea malaanonan (Blco.) Merr.	2.39	**1.69**	1.13	.031	**.022**	.014	Typical specimen; vessels larger than those of (30).
30. Parashorea malaanonan (Blco.) Merr.	1.87	**1.39**	.87	.029	**.021**	.012	
31. Pentacme contorta Merr. and Rolfe	2.18	**1.58**	1.04	.039	**.029**	.022	Density and size of vessels practically the same as (32).
32. Pentacme contorta Merr. and Rolfe	1.95	**1.45**	1.00	.038	**.031**	.021	
33. Pentacme contorta Merr. and Rolfe	1.84	**1.33**	.74	.038	**.023**	.016	Hardest of the three samples; growth somewhat abnormal.
34. Pentacme mindanaensis Foxw.	2.78	**2.05**	1.09	.029	**.023**	.017	Typical specimens; vessels almost twice as large as (35); density practically the same.
35. Pentacme mindanaensis Foxw.	2.52	**1.75**	1.17	.038	**.027**	.019	
36. Shorea balangeran Dyer	2.21	**1.54**	.82	.024	**.018**	.012	Lighter and softer than in (37).
37. Shorea balangeran Dyer	1.87	**1.35**	.61	.028	**.018**	.012	Sample typical of species.
38. Shorea eximia (Miq.) Scheff.	2.39	**1.78**	1.26	.034	**.024**	.017	Density of samples practically the same; vessels largest in (38) and narrowest in (40); all samples typ.
39. Shorea eximia (Miq.) Scheff.	2.26	**1.64**	1.13	.034	**.028**	.024	
40. Shorea eximia (Miq.) Scheff.	2.12	**1.48**	.82	.031	**.024**	.017	
41. Shorea falciferoides Foxw.	1.69	**1.34**	.95	.024	**.019**	.012	Specimen a typical hard Shorea.
42. Shorea guiso (Blco.) Blume	1.74	**1.33**	.74	.021	**.021**	.014	Specimens all typical of species.
43. Shorea guiso (Blco.) Blume	1.95	**1.45**	.69	.024	**.019**	.014	
44. Shorea guiso (Blco.) Blume	1.78	**1.32**	.78	.022	**.017**	.012	
45. Shorea mindanaensis Foxw.	1.95	**1.36**	.87	.029	**.021**	.016	Specimen typical.
46. Shorea negrosensis Foxw.	2.65	**1.72**	1.15	.043	**.030**	.024	Both samples typical; (47) is evidently a faster grown species.
47. Shorea negrosensis Foxw.	2.69	**2.31**	1.35	.034	**.026**	.017	
48. Shorea pallida Foxw.	1.29	**1.01**	.48	.031	**.022**	.015	Pores small, wood light and soft; specimen typical.
49. Shorea palosapis (Blco.) Merr.	2.00	**1.48**	.87	.038	**.025**	.021	(50) is evidently fast grown and has the largest pores; otherwise all samples are typical.
50. Shorea palosapis (Blco.) Merr.	2.08	**1.61**	.91	.039	**.029**	.021	
51. Shorea palosapis (Blco.) Merr.	2.08	**1.54**	1.13	.033	**.024**	.021	
52. Shorea philippinensis Dyer	1.56	**1.05**	.65	.031	**.022**	.016	Same as S. pallida (48); typ. specimen.
53. Shorea polita Vidal	1.52	**1.16**	.82	.028	**.028**	.017	
54. Shorea polysperma (Blco.) Merr.	2.26	**1.56**	.91	.034	**.024**	.017	(54) is densest of all the three samples; specimen abnormally hard; (55) and (56) are typical of species.
55. Shorea polysperma (Blco.) Merr.	1.82	**1.33**	1.04	.034	**.029**	.019	
56. Shorea polysperma (Blco.) Merr.	2.13	**1.51**	1.04	.029	**.023**	.016	
57. Shorea teysmanniana Dyer	2.39	**1.78**	1.39	.041	**.031**	.024	Density practically identical; (57) has larger pores.
58. Shorea teysmanniana Dyer	2.34	**1.69**	1.17	.039	**.027**	.017	
59. Vatica mangachapoi Blco.	1.61	**1.22**	.69	.024	**.020**	.014	Wood of (59) is typ. of species; it is harder than (60), pores 1½ as large.
60. Vatica mangachapoi Blco.	1.83	**1.42**	.78	.024	**.020**	.014	

tionably wider, and more or less twisted vertically. Within a species the number of measurements vary from 100 to 400 for length and 50 to 200 for width, the discrepancy in the figures depending upon the amount of available material. The measurements obtained from macerated material were checked by others from permanent mounts of the same specimens which had been prepared previously. No change in cell width was detected in material exposed to the action of the acid for a period of less than 30 hours. If the acid was permitted to act for 48 hours or more, partial disintegration of fiber took place.

All measurements were made with an ocular micrometer of the usual type which had been previously calibrated from a stage micrometer. In computing fiber lengths a 32 mm. micro-tessar objective was used with a 10 X eye piece, while fiber widths were measured successfully with a 4 mm. objective of the usual type. The speed with which measurements can be made depends to a considerable degree on the quantity of fiber on the slide. If the fibers are too numerous in the field of vision, the ends are not readily visible, interfering with accurate measurements. On the contrary, scarcity of fibrous material on the slide leads to delay owing to the necessity for the centering of fibers which happen to be some distance apart. Experience soon taught the amount of fibrous material for optimum results. In general, measurements were restricted to fifty or less per mount in order to obviate to a large degree the possibility of measuring the same fibers two or three times.

Table 1 indicates the fiber lengths and widths of thirty-three species of dipterocarps.

An examination of the tabulated measurements lead to a number of interesting deductions. There is apparently little variation in the fiber length of the dipterocarp group as a whole, but individual variations are both striking and significant. Fibers are longest as a rule in the softer members of the family, while the reverse applies in the harder-wooded species. For example, the average fiber length of *Anisoptera* spp. is 1.76 mm., *Dipterocarpus* spp., 1.77 mm., and the lighter *Shoreas* such as *S. eximia*, *S. palosapis*, and *S. teysmanniana*, 1.76 mm., 1.54 mm., and 1.68 mm., respectively. In contrast to the above, the harder woods of the family are proportionately shorter fibered. Species of *Hopea* possess an average length of 1.40 mm., *Balanocarpus* 1.38 mm., *Vatica* 1.34 mm., and hard *Shoreas* 1.46 mm. A like variation also exists in the different species of the same genus

as well as within the species providing the wood exhibits varying degree of hardness. This would seem to indicate that other things being equal, the fiber length of dipterocarp wood varies indirectly to the density.

An interesting variation is found in woods of like density where pores vary decidedly in size. The figures indicate that other things being equal, fiber lengths are directly proportional to the size of the pores. This was strikingly illustrated in *Shorea eximia,* where a number of specimens of practically the same density and hardness were available for study. In the sample (40) the vessels were most restricted in diameter, while (39) had somewhat larger vessels, and specimen (38) showed the maximum width. The corresponding fiber lengths were respectively 1.48, 1.64, and 1.78 mm., indicating a relation between size of pores and fiber length. A like situation is found in other dipterocarp species such as *Anisoptera thurifera, Pentacme mindanaensis, Shorea palosapis,* and a few others. One exception was noted to the above, namely, that of *Shorea polysperma* (55), which was collected in the western coast of Luzon. This specimen possessed smaller vessels and denser wood, but was the longest fibered of the three species studied.

A similar variation between fiber length and size of pores is likewise found in different species of the soft, light-colored dipterocarps, commonly designated as "white lauans." Within the "white lauan" group there apparently exists a second distinct sub-group which is characterized by wood of pale yellowish color and much finer pores. Included here are *Shorea pallida, S. polita, S. philippinensis,* and *S. mindanensis,* and undoubtedly a number of less known species. The fiber length of these forms average 1.10 mm. as compared to typical lauans, whose fiber lengths average 1.60 mm.

Bailey and Tuppen [7] have found that abnormal or depauperate plants tend to form shorter fibers than normal individuals. This was found to be the case in dipterocarps, since wood specimens from fast growing species or individuals generally possess larger pores and longer fibers than those of slower growth. This is analogous to the observations of Miss Gerry,[8] who found that the springwood of certain coniferous trees possessed, as a rule, longer fibers than the denser summerwood.

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[7] Bailey, I. W. and Tupper, W. W. "Size Variation in Tracheary Cells." Proceedings of the Amer. Acad. of Arts and Sciences, Vol. 54, No. 2, Sept., 1918.

[8] Gerry, Eloise. "Fiber Measurement Studies, Length, Variation: Where They Occur and Their Relation to the Strength and Uses of Wood." Science, Vol. 41:179, 1915.

In this connection it is generally conceded that the springwood part of the ring is formed when the growth tensity is at its height, while the summerwood is the result of sluggish growth towards the close of the growing season. As a result, the springwood of the annual ring is softer owing to the large size of the tracheary elements, their larger lumina and thinner walls. Tracheid length shortens regularly during the growing season until the outer layer of the summerwood is reached.

In conclusion it is of interest to note that the soft, light-colored dipterocarps, namely, *Shorea eximia*, *Pentacme* spp., and *Parashorea malaanonan* offer possibilities as a source of raw fiber in the manufacture of pulp and paper. One of the chief obstacles in the utilization of hardwoods in paper manufacture is the shorter fiber length as compared to conifers. In many cases, at least, this precludes their use in the manufacture of paper, except as a filler with longer fibered, usually coniferous, stock. *Populus tremuloides, P. deltoides,* and *P. grandidentata* are at present the most important hardwood species in the United States from the standpoint of paper manufacture. The average fiber length of these species is 1.13 mm. as compared to the light-colored dipterocarps enumerated above, which average 1.60 mm. This would seem to indicate that *Shorea eximia, Pentacme* spp., and other light-colored dipterocarp offer possibilities in the Philippines as a source of raw fiber for the manufacture of paper when used either alone or in admixture with bamboo, abaká (Manila hemp), maguéy, sisal, and other long-fibered stock.

The writer wishes to express his sincere thanks to Prof. H. P. Brown for helpful advice and guidance.

REPLACEMENT OF THE CHESTNUT[1]

By Joseph S. Illick

Chief, Office of Research, Pennsylvania Department of Forestry

The chestnut blight appeared in Pennsylvania about twelve years ago. The disease spread rapidly and in a few years most of the chestnut trees in the eastern and southeastern parts of the State were infected, and almost every infected tree was killed within a few years. It migrated westward and northwestward at a variable rate, spreading with almost incredible rapidity along the foothills and slowing up somewhat upon reaching higher altitudes, broad limestone valleys, and other natural barriers.

The present status of the chestnut blight in Pennsylvania may be set forth by dividing the State into three distinct regions:

Region 1.—Comprises that portion of the State lying southeast of a line drawn from Honesdale, Wayne County, through Mauch Chunk and Harrisburg to Chambersburg in Franklin County. Most of the trees in this region were infected prior to 1913.

Region 2.—Comprises the mountainous areas west and northwest of Region 1, and extends westward to the Allegheny mountains. The western boundary follows approximately a line drawn from Sayre, Bradford County, through Williamsport to Bedford in Bedford County. In this region the disease reached its height between 1913 and 1918.

Region 3.—Comprises the area west and northwest of Region 2. Here the blight is still in the initial stage of invasion, most of the infection having taken place since 1918, and in some localities the disease is still rare.

A general survey of the situation shows that the chestnut blight is now found throughout the entire range of the chestnut in Pennsylvania. The degree of infection and the extent of damage ranges from a stage of *initial invasion* in Region 3 to a *complete destruction of all merchantable stands* in Region 1, and an intermediate condition of invasion in Region 2.

[1] Read before the Society of American Foresters at its annual meeting in New York City, December 20, 1920.

That all merchantable stands of chestnut in Pennsylvania will be killed is now conceded, even by the most conservative. This does not imply that the chestnut as a species is doomed. Hodson[2], page 3, may be on the right track by suggesting a special study of the present situation of chestnut blight on the hypothesis "that the chestnut is developing by natural process, immunity to the blight through struggle with it." There may still be a ray of hope for the chestnut. Probably the malady will generate its own anti-toxin. Existing conditions show, however, that all merchantable stands of chestnut in Pennsylvania are now dead or dying or will be killed in the near future. A number of things must be done to meet the situation. The first step necessary to take is the salvaging of all merchantable chestnut by prompt and proper utilization. Ziegler[3], page 3, writes that "the first problem and the one that has been delayed too long by practically every chestnut timber-land owner, is one of immediate utilization. . . . A failure to get out the dead material will subject the forests of southern Pennsylvania to a fire hazard that could easily ruin a large part of the other forest species left in them." It is imperative that an effective program of utilization be put into practice right now, and it should extend to all chestnut stands, not only to the dead, dying and damaged trees, but also to those which are still healthy, but will soon fall victim to this powerful disease.

But immediate and proper utilization alone will not clear up the situation satisfactorily. More is required, for the disappearance of the chestnut has created vacancies in the forests which must not remain. They must be filled up. The chestnut must be replaced with other valuable trees. In outlining and developing a proper course for action two major questions present themselves for consideration and deserve immediate attention, namely:

(*a*) What is nature doing to replace the chestnut; that is, to what extent and in what manner are the chestnut vacancies being filled up naturally?

(*b*) What must man do to supplement nature's efforts to replace the chestnut?

A preliminary study of the problem shows that there are many replacement factors which influence the conversion of extinct and

[2] Hodson, E. R. Is American Chestnut Developing Immunity to the Blight? JOURNAL OF FORESTRY, Vol. XVIII, No. 7, November, 1920.

[3] Ziegler E. A. Problems Arising from the Loss of Our Chestnut. *Forest Leaves*, August, 1920.

existing chestnut stands into stands composed of other valuable species. All the influencing factors may not be operative in every locality, but there are a few fundamental factors which are of considerable importance, and will be discussed briefly.

The chestnut formerly occupied so large an area in Pennsylvania, and its destruction was so complete, that the belief prevailed during the height of the epidemic that numerous vacancies, which aggregated an enormous area, would be created and remain unoccupied for a long while, at least no valuable trees would appear upon them. That this belief was incorrect, is now becoming evident in places where the blight has reached the final stage of its invasion. In Region 1, and to a less extent in Region 2, the blight has now passed through the three stages of its invasion, namely, *initial*, *intermediate*, and *climax* (*final*) and one is now able to observe what nature will do to replace the chestnut. A ray of hope is beginning to appear over what is regarded as a sad forest tragedy, for natural replacement is more complete and better in quality and quality increment than was anticipated. The blanks left after nature has had sufficient time to show what it can do are fewer in number and less extensive in area than was formerly predicted. Foresters and woodsmen are now heard to say: "We do not miss the chestnut as much as we thought we would;" "We can get along without the chestnut;" and "We had the chestnut to spare." The problem is, therefore, in many places not one of forest tree restoration on blank vacancies, but of the control of forest tree replacement.

The nature of the material which is replacing the chestnut varies with locality, site, slope, remaining species, forest type, and many other influencing factors. Spaeth[4] states that in central New England "Red oak and white ash are the most important species replacing to a large extent the dying chestnut."

Ten of the most important species associated closely with the chestnut in Pennsylvania are:

I.—On Hillside Sites (dry):

1. Chestnut or rock oak.
2. Pitch pine.
3. Black locust.
4. Black birch.
5. Black oak.

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[4] Spaeth, J. Nelson. Growth Study and Normal Yield Tables for Second Growth Hardwood Stands in Central New England. Harvard Forest Bulletin, No. 2.

2.—On Foothill Sites (moist):

6. Red oak.
7. White oak.
8. White ash.
9. Tulip tree.
10. White pine (toward the north and on northern exposures).

There are many other companion species of the chestnut, but a large number of them play a subordinate role in its replacement. Much has already been written about the ten species named. Some of them are looked upon with favor, while a few are regarded as inferior or undesirable. Those species held in favor, such as white ash, red oak and tulip tree, will probably be given conscious care and assistance in extending themselves into the newly created vacancies, but it is even more probable that the remaining species, which are regarded as inferior and undesirable, will be looked upon with disfavor, and an attempt may even be made to eliminate them from the forest structure. Such an attempt, in my judgment, would be neither economically wise nor silviculturally recommendable. The time is not yet at hand to develop a program of forest production based solely upon a few select super-species.

I want to present some facts and figures setting forth the merits of several species often classified as inferior or undesirable. For this purpose I have selected chestnut oak, pitch pine, and black locust.

The impression prevails that chestnut oak is a very slow grower and consequently should not be favored in the forest stands. Foster and Ashe[5] state that "the rate of growth of chestnut oak is slower both in height and diameter than that of any of the associated oaks, and that on the account of its relatively slow growth and the comparatively low value of its timber, the reproduction of chestnut oak should not be favored in situations where others of greater value, like white oak, reach large size and form high-grade timber. In such situations both seed and sprout reproduction of chestnut oak should be discouraged." Elliott[6] writes that "at best chestnut oak is a rather slow grower."

That the prevailing opinion about chestnut oak is not fully correct is shown by recent growth studies of plantations and natural stands. The following table shows what may be expected of chestnut oak on a good gravelly soil on a well-drained mountain slope with a southern exposure:

[5] Foster, H. D., and Ashe, W. W. Chestnut Oak in the Southern Appalachians. Forest Service Circular 135.

[6] Elliott, S. B. The Important Timber Trees of the United States, page 240.

Year	Age years	Total height feet
1904	1	.4
1905	2	.9
1906	3	1.5
1907	4	2.1
1908	5	2.7
1909	6	3.4
1910	7	4.1
1911	8	4.7
1912	9	5.8
1913	10	6.7
1914	11	7.6
1915	12	8.6
1916	13	10.0
1919	16	15.4
1920	17	17.8

Observations and field studies of chestnut oak, extending over several seasons have convinced me that its rate of growth in height, diameter, and volume has been underrated. Its actual growth differs considerably from the apparent growth, the latter having probably been the basis upon which much of the existing information contained in forestry literature about this tree, was based. The growth rings of chestnut oak, particularly in case of specimens of sprout origin, are not an accurate indicator of age. Neither are the growth demarcations on the twigs an accurate basis for determining age. Two or even three growth periods occur frequently in a single growing season. The several growth periods are clearly demarcated on the twigs, and on the cross-section of the stem occur rings for each growth period. This periodicity of growth within a single growing season may be responsible for the somewhat erroneous belief that the growth of chestnut oak is extremely slow. The low yield generally credited to this tree may also be due to an inadequate and inaccurate knowledge of its real growth. These observations and conclusions on periodicity of chestnut oak growth coincide with the experience of bark peelers, who recognize each year, two and sometimes three bark-peeling periods which cover the time when the "sap is up" and the twigs are making their elongation.

Sprouts are common, which during youth make an average annual height growth of two to four feet. Occasional sprouts make a height growth of 5 to 6 feet in a single season, but in nearly all cases of unusual height growth it is laid on in two or more installments. For example, two of the many sprouts examined and measured, each grew to a total height of 6 feet during 1920. One grew 3 feet and 8 inches,

then rested for a while and later added 2 feet and 4 inches. The other laid on the height growth of the season in three installments of 30, 18, and 24 inches, respectively, with a resting period between each elongation.

The diameter growth of chestnut oak is also worthy of some consideration. Its rate of growth is given in the Woodsman's Handbook as 3.3 inches breast-high diameter and 20 feet in height at the age of 30 years, and a breast-high diameter of 5.6 inches and a height of 35 feet at 50 years. These figures are exceptionally low. A few of the trees in the 17-year-old plantation on the Mont Alto Forest have a breast-high diameter of 3.5 inches and most of them exceed 2.5 inches. Sample plots have been established in which the chestnut oak trees show a breast-high diameter of approximately 6.5 inches at 30 years, and 10 inches at 50 years. Trees upon dry, steep, and extremely rocky hillsides show a diameter of 11 inches, a height of 70 feet with a clear length of 54 feet at the age of 65 years. It should be realized that this growth took place with the chestnut oak growing in constant and keen competition with the rapid-growing chestnut. It seems reasonable, therefore, to assume that a better growth would have been possible if the chestnut oak would have grown up with an equal competitor or unhindered. The belief that the chestnut oak was held back considerably by the chestnut is supported by the fact that an acceleration of growth is now beginning to show up on the trees which grow up in mixture with chestnut, the latter having been killed several years ago by the blight.

The foregoing facts and figures about the actual growth of the chestnut oak, the good quality of its wood, the richness of its bark in tannin, its unusual capacity to sprout in youth, its adaptation to the dry sites now occupied by the disappearing chestnut, and the short rotation under which it may be handled, recommend a fuller study of its real silvical characteristics and economic possibilities.

The chestnut oak will replace the blight-killed chestnut to a greater degree than any other single species, for in most places it is the principal companion of the chestnut. Along the base of mountain slopes in southern Pennsylvania, chestnut oak frequently comprises 20 per cent of stands, while along the middle slope it comprises from 30 to 40 per cent, and toward the top of the slopes and upon the ridges it frequently comprises 60 per cent. On many acres there exist also from 2,000 to 5,000 seedlings, ranging in height from six inches to six feet.

awaiting a liberation, and if given sufficient light and plenty of room they will develop into thrifty stands. Not all of these small trees will be able to respond favorably to the new and freer environment, for some of them have surely been suppressed beyond recovery, but among them there will be a sufficient number to develop into stands with a satisfactory density.

Pitch pine is also a close associate of the chestnut. They appear together in many places, particularly on dry, gravelly, and sandy mountain slopes, upon which some of the more exacting trees do not thrive. The actual height growth of pitch pine, just as that of chestnut oak, is in many cases greater than the apparent growth. It also makes, especially in youth, two and occasionally three growth additions in a single season.

In my opinion, the giving of a little conscious care to the stands from which the chestnut is disappearing, will bring in pitch pine in considerable quantity, and help form satisfactory new stands. Pitch pine is worth favoring on account of its wide natural range, modest silvical characteristics, satisfactory growth and yield, and in addition to all these desirable attributes, it is the most fire-resistant forest tree native to Pennsylvania.

Black locust is another associate of the chestnut. Its association, however, is more local than that of the chestnut oak and pitch pine. A comparison between the present composition of forest stands and earlier reports of its occurrence show that it is becoming more abundant. Records indicate that a marked increase occurred immediately after the removal of the original forest, and if present observations prove correct, it will show another marked increase in places vacated by the chestnut. Kohout[7], reporting upon the change of vegetation along Martin's Mountain near Hyndam, in Bedford County, Pennsylvania, writes: "Here, where formerly flourished different varieties of oak and other deciduous trees, the locust has now commenced to grow and is distributed and dominant over the entire mountain, and will, undoubtedly, in the near future, be the prevailing wood, since the light sandy soil particularly favors the growth of this kind of tree." The black locust trees which followed the original lumbering operations, and at the time of lumbering ranged in size from small seedlings to trees with a diameter of 3 to 7 inches and a height of 20 to 35 feet,

[7]Kohout, Wm. G. Annual Report of Division of Forestry in Pennsylvania for 1897, pages 197-201.

have since developed to maturity, and during the past few years have been cut for tree nails, insulator pins, and posts. They had attained a height of 50 to 75 feet and a diameter of 7 to 16 inches. A single specimen measuring 83 feet in height and producing 16 insulator pin sections, each 57 inches in length.

Black locust, as a rule, occurs solitary or in small groups, rarely in pure stands. It usually occurs in mixture with chestnut, chestnut oak, pitch pine, black oak, and other species adapted to rather dry mountain soil. It is also common in abandoned fields and along fences.

Many small black locust trees have been killed by the locust borer. Much defective wood is produced by the locust heart rot, *Polyporus rimosus*, and by the locust borer, *Cyllene robiniæ*. Of the two, the borer does by far the most damage. Buttrick[8] goes so far as to say that "the locust borer makes the successful cultivation of black locust in America almost impossible." In my opinion, this statement is entirely too sweeping and untenable. Observations and studies show that the locust borer does more damage on slopes with a southern exposure and on dry mountain tops, than on northern exposures and moist ravines. The following figures are offered in support of this conclusion:

	First-class wood (cords)	Second-class wood (cords)
Shorty ridge (northwest slope)	32 (91.4%)	3 (8.6%)
Top of knob	43 (71.7%)	17 (23.8%)
Bottom of knob	52 (75.5%)	16 (25.5%)

These figures show a difference of almost 20 per cent between the amount of first-class wood derived from a moist slope with a northwestern exposure and a dry mountain top. Of 342 cords of wood cut, 265 cords (77.5 per cent) were first-class and 77 cords 22.5 per cent) second-class.

The scattered natural occurrence of black locust, its satisfactory growth in mixture with other species, and the relatively low damage by the borer on the northern and western exposures and upon moist sites suggest that a serious mistake was made in planting pure stands of black locust in wide openings, and upon lowland sites with a south-

[8] Buttrick, P. L. American Trees for Forest Planting in France. JOURNAL OF FORESTRY, Vol. XVIII, No. 8.

ern exposure. A satisfactory growth could hardly be expected upon such unnatural conditions. The failure of the black locust plantations set out by the Pennsylvania Railroad has given the tree "a black eye." It is not fair to condemn the tree on so few trial experiments. However, if the failures are chargeable they should be charged against the forester who recommended the setting out of the trees under such unnatural conditions, rather than against the tree itself. In my opinion, foresters will act wisely by favoring the black locust in mixture with other trees in filling up vacancies produced by the disappearing chestnut.

Chestnut oak, pitch pine, and black locust are only three of the many trees which are replacing the chestnut on dry mountain slopes and mountain tops. There are others, such as black oak, pignut hickory, black birch, table mountain pine, and Jersey or scrub pine which are also helping fill in the gaps. Some may wonder why I mention table mountain pine and Jersey or scrub pine. Table mountain pine occurs locally in pure stands on the mountain tops of southern Pennsylvania, and has been utilized on a small scale in the manufacture of charcoal. Scattered specimens occur among the hardwoods on the slopes and attain a larger size than in the pure stands on the mountain tops. One specimen which grew up among the chestnut attained a diameter of 23 inches and a height of 72 feet with a clear length of 45 feet. This tree was larger than the maximum size given for the species by Dr. C. S. Sargent in his Manual of North American Trees. It grows not only upon the mountain tops and upper slopes as the name indicates, but makes its best growth and attains its greatest size best form along the foothills and in the valleys, where it occurs occasionally. I have found thrifty trees in the woodlots of agricultural valleys and upon the rocky islands of the Susquehanna River at an altitude of only 200 feet above the sea level.

Jersey or scrub pine is also worthy of consideration. It is a very ordinary tree, but by no means should it be despised. There is room for it in many forest stands. It extends northward in Pennsylvania along the west branch of the Susquehanna to Jersey Mills along Pine Creek in Lycoming County. About ten miles south of its northern limit, 18,000 board feet of it was cut on a single woodlot and used in the construction of one of the finest barns in northern Pennsylvania. Fine specimens remain in the woodlot. They grew up in mixture with the hardwood and are regarded as satisfactory members of the forest structure.

In my opinion, nature will, to a large extent, replace the chestnut with satisfactory trees. In moist situations the replacement will be more complete and more satisfactory than upon the drier slopes, for in such places the vacancies will be relatively less extensive and the companion species more desirable, among them being the tulip tree, white ash, red oak, white pine, red maple, white oak, and a few other species. Upon the drier slopes the vacancies will be more extensive and the companion species less valuable. Upon some sites and in special places the natural growth may not suffice to establish satisfactory stands. In such places the natural growth should be supplemented by planting. All planting should be planned carefully and carried on with great care and good judgment. What species to use is probably the most difficult question to decide. A study of extensive planting upon typical chestnut sites has convinced me that pitch pine (*Pinus rigida*) jack pine (*Pinus banksiana*), and scotch pine (*Pinus sylvestria*) are satisfactory species to use. These three tree species are doing well in plantations established upon sites formerly covered with chestnut. Some of the plantations were set out 11 years ago. It now appears as if the jack pine would make the most rapid height growth, at least, for a decade or so, while a mixed plantation of pitch pine and Scotch pine planted in 1911 shows an average total height of 15 feet, both species having grown at about the same rate.

White pine may be used upon moist situations occurring at lower elevations. It should be limited to moist sites. Even though it may start to grow well on drier situations, it is quite probable that it will ultimately give unsatisfactory results.

Promiscuous planting, and a poor selection of species for planting, will not produce desired results. In selecting the species for planting an attempt should be made to take advantage of what nature teaches. It may offer valuable suggestions, and an attempt to deviate too far from its way of doing things, may ultimately result in poor stands or even a complete failure. In the end, the best results will be attained by taking full advantage of all existing tree growth with a present or prospective value, and by giving full credit for all good points possessed by ordinary trees.

SOME OBSERVATIONS ON EMPIRICAL FORESTRY IN THE ADIRONDACKS [1]

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It can be claimed with some degree of correctness that the greater part of the trend of forestry thought and practice in this country has been developed from the various experiments in the Adirondack region. And as an unfortunate climax it has followed that the thought and ideas produced by these experiments have developed faster than their results have justified. Following the investigations of Fernow and Graves, the conclusions of our professional foresters swung in a circle away from the idea of clear cutting and planting, through all the variations of the selection system as applied on a diameter limit basis, until now, backed by the opinion of a number of men, there is a distinct trend back to the old idea of clear cutting and planting. Before our ideas become crystalized into conclusions, and these conclusions into practice, it is only fitting that we stop and note some of the results of forestry and forestry practice as demonstrated by actual results within this region. This article does not presume to offer anything further than that, and as such it is presented. It is based on a series of observations extending over a period of three years in that part of the Adirondacks between Wanakena and Axton, north and west.

TYPE

The Fundamental Importance of Type

Division of the Adirondack forest into types is necessary. Operations or investigations on any extensive Adirondack area bring out the great differences in forest composition and topography, and these differences have been used as the basis of the definition and delineation of the major types of the region. While but four major types are recognized and described, it is believed that very little intensive work can be accomplished until a *more minute division* is made, and the physical factors which create the minor differences are recognized and studied. Changes in soil depth and composition, drainage, depth of

[1] Read before the annual meeting of the Society of American Foresters, at New York, N. Y., December 20, 1919.

humus, forest composition, and even shrub and herbaceous cover, all react to cause differences in forest reproduction within a type.

Swamp.—The true swamp type of the Adirondack region is a balsam and spruce mixture on flat, poorly drained land, with some areas along streams and lake margins where white cedar and hemlock are prominent. The soil may be deep or practically lacking, as on some boulder formations, but the permanent water table is generally so high as to make natural swamps a poor site for tree growth. The floor of the forest is spongy with common occurrence of sphagnum. This is the condition of the drained swamp.

Where the undrained swamp prevails the typical tree growth is pure black spruce, and any appearance of balsam in the mixture is evidence of a flow of water in that area, either by seepage or direct stream drainage. The margins of bog swamp areas may have balsam in mixture and may be as wet to all appearances as the spruce section of the bog, yet there is doubtless movement of water from the higher land through the balsam section of the swamp which brings about the change of mixture commonly observed.

Open heath covered bog with stunted growth of black spruce occurs over considerable areas of the undrained swamp type. A slight rise of the water table in such swamps is soon apparent in the loss of vigor and death of the spruce, while an equivalent lowering of the water table will result in a distinct recovery of the stunted trees and more rapid growth. This variation of the commercial swamp type offers possibilities of drainage in many places which will react favorably in introduction of species from the higher ground.

The swamp type has a normally high percentage of windfall due to the poor root support, so that the existing forest is usually young as compared with the upland types. The upper margin of the swamp may be defined as the line at which a soil layer of depth sufficient to sustain mature hardwoods exists above the water table, and where the floor of the forest loses its spongy character. Yellow birch appears in commercial size at about this line, and is surpassed by the red maple only in ability to take a wet site. The area of swamp will be reduced in the second growth forest on clear cut areas due to the encroachment of both yellow birch and red maple from the margins.

Spruce Flat.—This type may be crowded out in some places by the abrupt approach of steep hardwood slopes to the edge of a swamp, and attain the spruce flat may cover extensive areas around the swamps on the flats, knolls, and lower ridge slopes. The lower margin extends

to the edge of the swamp, stream, or lake and is marked by the appearance of soft maple and birch on a moist soil covered with humus and lacking the spongy characteristic of the swamp.

The upper margin is marked by the disappearance of balsam and appearance of beech in the mixture. The soil loses its humus covering, and there appears instead a shallow layer of hardwood leaf mould with a firm, well-drained soil beneath. Sugar maple is not commonly found in this type. The characteristic species are red spruce, balsam, hemlock, yellow birch, and red maple. Birch exceeds in number all other hardwood species in the type. The predominance of softwood species, and moist condition of soil when shaded, and extreme dryness when not shaded, influence to a marked degree the amount and character of reproduction to be expected.

Mixed Hardwood.—This type has already been defined as to its lower margin, and needs only general characterization. While that zone of the ridge slopes having comparatively deep soil may be defined as hardwood type up to the point in elevation where spruce again appears as the dominant, there is still a wide variation in hardwood areas. The amount of moisture and soil depth both influence the composition. The lower, moist hardwood land will have more birch than the better drained parts. Areas of several acres may be found covered by stands of pure sugar maple, while shallow soils on exposed ledges are pure softwood, largely hemlock.

The hardwood type has reproduced itself by natural selection mainly, yet the characteristic of windfall and even aged growth is common on small areas. Variation in the type is wide, and the composition of the forest changes in the several sections of the Adirondack region.

Upper Slope.—This has been defined as to its lower margin as that point in elevation in the mixed hardwood forest where spruce again becomes a dominant. As a softwood forest the type extends over the upper slopes and mountain summits, grading off, in its upper limits, according to elevation and locality, into the typical stunted growth of a sub-arctic or alpine type of vegetation. Yellow birch is the most widely distributed and best developed hardwood tree of this type. It can thrive better than maple or beech on the thin soils, and can reproduce best of all hardwoods in the deep humus found under the type.

INFLUENCE OF LOGGING ON THE FOREST

The early logging operations may be designated as a selection method, in which the amount of timber removed was not enough to interfere

with the crown of the forest, or to make any greater change in its composition than the removal of mature timber itself. In this way the white pine and spruce saw timber was cut and in some localities the large hemlock. Subsequent cutting may be classified under three heads:

1. Cutting of softwood to a diameter limit.
2. Cutting of all merchantable softwood.
3. Cutting both hardwood and softwood as far as it is merchantable.

Cutting of Softwood to a Diameter Limit

The condition of forest resulting from this method of management varies with the lower limit of cutting, the type, and the period in which cutting was done. Such management is the outcome of early agitation for conservative methods following studies made some 20 years ago. The first cut of spruce for pulp was made to a diameter limit of 12 inches at 4½ feet from the ground, while a later limit of 10 inches at the stump height has resulted in removal of practically all merchantable soft woods. The most of the early cutting left the swamps intact and also the hemlock stands. These were then removed in a later cut at a considerable profit resulting from increased stumpage values. Results from this method of cutting have shown after a lapse of 20 years:

1. Heavy windfall of softwoods in the swamps and on thin soiled ledges.

2. Failure of medium diameter classes to recover under the closure of hardwood crowns.

3. Complete depletion of softwood seed trees on some hardwood acres.

Cutting of All Merchantable Softwoods

The results from this method of cutting have been complicated by the size of the softwoods considered merchantable at the time of the cutting and which has varied, from time to time, to such an extent that no standard of result is attainable. On flats and hardwood lands, the conservative removal of merchantable softwood will make the resulting forest more largely hardwoods, but will not exclude softwood reproduction. Some spots will be clear cut, and others will have a comparatively complete crown cover of birch and red maple. When the forest is opened severely, there will be a large mortality due to windfall and exposure.

Clear Cutting Hardwoods and Softwoods

In the true sense of the word, there has absolutely been no "clear cutting" carried on in the Adirondack forest, and the nearest approach to this condition has been in those logging operations where hardwoods of small diameter, softwoods less than 4 inches on the stump, and cull trees are left. Such a removal as this practically amounts to clear cutting and within such delimitation, clear cutting has been and is being practised in the Adirondacks.

Swamps.—In cutting swamp areas the indicated method is one of clear cutting down to as small a size as is practicably feasible. Any other method than this will result in a high degree of windthrow. Softwood reproduction of desirable species for pulp and lumber production comes in naturally, easily, and in good amount. Growth is rapid. Balsam is a dominant and will become more so in the second growth swamp forest. It seems well indicated that as reproducing units, the swamp areas can take care of themselves, although a considerable assistance might be inaugurated by the girdling out of the scattered cull hardwoods which occupy needed space.

Spruce Flat.—This type contains a large per cent of birch and maple in mixture with the softwood species, spruce and balsam, birch exceeding in number all other hardwood species. The hardwoods here offer a severer degree of competition to the softwoods and upon the removal of the latter alone or in a selection cutting removing both species in larger sizes only, these hardwoods will persist and by their closing of the openings in the crown cover will seize and hold the site. A removal of a part of the hardwoods at the time of the removal of the softwoods will undoubtedly improve the conditions of the area since it will induce a better reproduction of desirable softwood species and quicken the recovery of the advanced growth of spruce and balsam. In any case it will be found that in the second growth forest there will be a larger per cent of hardwoods which will dominate the softwood species to such an extent that the ultimate harvesting of the latter may only be achieved after a releasement cutting of hardwoods undertaken some years in advance of the softwood cutting.

While, as previously stated, there is no such thing as absolute clear cutting applied in the Adirondacks today, any cutting within this type of such degree of clearness as to leave only inferior sized softwoods and cull hardwoods reacts very unfavorably upon any species. The presence of deep humus and the fact that this dries out severely on

exposure to the sun prevents tree seeds from germinating and checks the growth of seedlings. Moreover a severe cutting within this type not only causes desiccation in the soil but also the mortality in the standing trees that remain. This mortality seems to be mainly induced by exposure and sun scald but is also probably caused by the effect on shallow rooted species of rapid and undue drying in the surface layers of the soil. It is not confined to hardwoods alone but is common to all species. It is to be observed, however, that the greater part of the softwoods left after the logging will probably be of small size, rather than defective, and hence when a greater number of them is found in the mortality record, there is offered a distinct reduction in the chances for a second crop.

TABLE 1.—*Data Regarding Average Sample Acre—Spruce Flat, near Wanakena, St. Lawrence Co., N. Y.*

Species	Number of trees.				
	In original forest.	Removed in cutting, 1908.	Standing immediately after cutting.	Died in the next 11 years.	Standing in June, 1919.
Hemlock	17	3	14	9	5
Spruce	122	56	66	30	36
Balsam	22	12	10	6	4
Beech	13	...	13	11	2
Soft maple....	31	4	27	15	12
Hard maple...	1	...	1	...	1
Yellow birch..	37	8	29	9	20
Black cherry...	1	1	...	...	...
Totals	244	84	160	80	80

A general conclusion seems to indicate that following a heavy cutting on this type the need of girdling the cull hardwoods will, to a certain extent be obviated on account of the consequent natural death of a considerable part of them within the next 10 or 15 years. It should be pointed out, however, that girdling over large areas within the type, and on adjacent types, would mean the disappearance of potential undesirable hardwood seed trees and a consequent favoring of more desirable softwood reproduction, both in its seedling and advanced growth.

The degree of the influence of the condition just described on cut over lands within the spruce flat type seems to be directly proportional

to the severity of the cutting, and, as would be naturally expected, is even more marked and accentuated on burned over spruce flat areas. Raspberry bushes, the first ground cover on the site, leaf out so late as to offer no shade necessary for the germination of the seedling. Other reproduction is only established as a result of the growth of a conversion forest of fire cherry and aspen. Small burns of this type, and under favoring conditions, apparently, of moisture soil and seed trees may be expected to reproduce a conversion forest of pure yellow birch in addition to and underneath the aspen, and these two form a nurse crop under which more tolerant hardwoods and especially softwoods can enter.

Height growth studies on spruce growing understands of this character show an annual height growth of two-tenths of a foot. This is relatively slow, but it is faster than that of spruce growing under the cover of the virgin stand on the spruce flat type. Stands of this character could undoubtedly be artificially thinned to advantage. This will allow an increased growth in the spruce understory and undoubtedly shorten the period of conversion to the stabilized form.

As a general conclusion regarding this type, it is believed that it represents the most critical equilibrium between ecological factors on one hand and resultant growth on the other, that we have in the Adirondack forest, and that it reacts more quickly and more emphatically to disturbance than do any of the others. A modified selection system permitting of the removal of only the larger sized trees seems to be indicated by the likelihood of such method affecting the disturbance of this equilibrium the least. The importance of management within the type is also minimized by its relatively restricted area, but wherever met with to an extent justifying its separate consideration a carefully and detailed study should be made and its results conservatively applied.

Mixed Hardwood Type.—The hardwood type is the major type both in area and volume in our Adirondack forests, and its management presents many varied and difficult problems. The prior removal of hardwoods in order to insure softwood reproduction is not to be advocated due to the high degree of breakage to be experienced in the softwood trees. The disposal of hardwood slash after logging is not one of the least of the yet unsolved problems within this type.

Considerable variation exists within this type due to difference in soil moisture content, depth of humus, and the character of the main stand. On some dry ridges where there were originally no softwoods, nothing more than a pure hardwood stand can ever be expected. The

density of such stands in young second growth is high and underplanting with softwoods is not to be advocated. Such areas should be managed for hardwood production only in accordance with the needs of the rapidly increasing hardwood using industries.

Other areas, smaller and more local in extent, where a deep layer of softwood humus has been formed, produce in the original forest the purest of softwood stands, and on cutting will recover as such, nursed with a certain temporary amount of aspen and fire cherry to the almost absolute exclusion of other hardwoods. Between these two extremes there are all gradations of mixture and purity.

It should be pointed out that these hardwood stands display a very slow growth. A rapid replacement of the mature stand can only be accomplished by breaking up its crown cover. Such an operation will show a great acceleration of growth to softwoods, although it takes from three to seven years before this accelerated growth is shown. Younger trees show the quicker recovery. The breaking up of the hardwood crown also induces the production and quick growth of hardwood species and encourages a development of straight boles.

These openings will also achieve a mortality of the surviving trees, and if carried to excess may result in the death of many of the smaller trees of the stand, including the more desirable softwood species. The problem really resolves itself into a determination of the amount of crown cover to leave as to induce accelerated growth in desirable species on one hand and yet protect the soil from undue drying and the consequent crippling or death of the young trees on the other. It should also be a recognized practise, that the removing of the mature crown cover does not complete the silvicultural measures necessary to insure the full and quick return of the second crop, and that the second growth stand itself must be subsequently thinned, or even partly removed, at as early a date as is practicable to secure a full crop of softwood.

Upper Slope Type.—The local importance of this type as confined to high mountains situations, the shallowness of its soils, the high liability to windfall and its absolute protective character make it one not of commercial importance and designate its management as that for the protection forest only.

BURNS

The presence of large areas of burn in the Adirondacks demand special consideration. Planting can be carried on with success provided

that the planting is undertaken soon enough after the fire as to enable the planted species to get a start over the inevitable competition with native growth of ferns, brake, shrubs, and brush. Underplanting in a sapling stand gives little promise of success and should be avoided over wide areas. If the planting operation is delayed until a stand of hardwood saplings gets started on the site, it seems best to abandon the operation of artificial reproduction and let the area revert to its forested condition naturally.

PLANTING ON CUT-OVER LAND

The first forestry operation within the Adirondack region were undertaken with the direct purpose in mind of achieving a desirable reproduction on cut-over land by artificial means. These plantations which are upwards of 20 years old were placed for the most part on open or burned-over land. While they had given a full demonstration of success as such, from the standpoint of management and especially of management seeking the best plan applicable to its cut-over areas, they do not solve the problem entirely. The difficulty presented has been that of getting cut-over land free from slash, bushes and hardwood brush at the time of the planting, without running fire over the land first. There is not a single instance to be found where clear-cut forest land has been planted without first a preparatory burning to clear the site which has lived to a size suitable to show results. That such a plantation was undertaken in the Axton-Wawbeek areas is well known, but these special plantations have been wiped out by fires which swept over a part of this area subsequent to the relinquishment of its management by Dr. Fernow.

The nearest approach to the desired condition is to be found in the Wawbeek planting area, along the Tupper Lake Wawbeek road, about a mile west of Wawbeek. The area was planted in 1904 behind a shelter belt of uncut timber, in full accordance with the experimental plan developed by Dr. Fernow. The original forest type was mixed hardwood having a small number of spruce in the mixture. The soil is glacial boulder till and of good depth except for one ledge outcrop. The slope is of medium grade and faces northerly, extending down to spruce flat type on the north edge. All of the old stand of timber was removed, even to the cordwood, and the brush was burned in small piles. Judging from the number of fire-scarred stumps, the burning destroyed a large amount of potential hardwood reproduction.

TABLE 2.—*Number of Trees Per Acre of Plantation, Planted 1904, Near Wawbeek, Franklin County, N. Y., Based on 5.2 Acres of Calipered Strip. Record Taken July, 1919.*

D. b. h. o. b. inches	White pine	Red pine	Scots pine	Norway spruce	Blue spruce	Red spruce	Balsam fir	Sugar maple	Red maple	Black cherry	Fire cherry	Aspen	Beech	Yellow birch
0*	17.31	.....	0.39	75.00	7.12	10.58	13.08	.....	.....	9.81	73.40	.....	.....	.....
1	50.90	0.576	0.19	124.50	0.96	4.62	5.95	95.10	47.50	15.58	95.10	74.40	28.63	61.90
2	50.40	0.576	20.79	78.50	.....	0.77	1.34	29.20	22.80	15.39	54.00	91.40	6.54	49.60
3	24.80	0.769	22.05	20.29	.....	0.58	1.54	3.27	3.46	9.81	6.15	72.10	0.77	16.70
4	9.60	1.155	16.72	5.57	.....	0.39	0.77	.....	.....	2.89	0.7	36.80	.....	1.34
5	1.54	1.920	11.70	0.39	.....	0.77	0.77	0.19	.....	0.39	.....	8.84	0.19	0.38
6	.....	1.155	5.38	0.19	.....	0.77	0.58	0.19	.....	.....	.....	0.77	0.38	.....
7	.....	0.190	0.96	0.19	.....	0.39	0.19	.....	.....	.....	.....	.....	0.38	0.38
8	.....	.....	.....	.....	.....	0.58	.....	.....	.....	0.39	.....	.....	.....	0.38
9	.....	.....	.....	.....	.....	.....	0.	.....	.....	.....	.....	.....	0.38	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.38
11	.....	.....	.....	.....	.....	0.19	0.19	.....	.....	.....	.....	.....	0.38	.....
12	.....	.....	.....	.....	.....	.....	0.19	.....	.....	.....	.....	.....	0.38	0.38
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.38	.....
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	.....	.....	0.19	.....	.....	.....	.....	.....	.....	.....
Total	154.55	6.331	78.18	304.63	8.08	19.64	24.93	127.95	73.76	54.26	229.42	284.31	38.41	131.44

*Softwoods less than 4 feet 6 inches in height.

A caliper record reduced to an acre basis, computed form 5.2 acres of actual strip record is presented. The planted species are white pine, red pine, Scotch pine, Norway spruce, and blue spruce. The species that have reproduced naturally are red spruce, balsam, sugar maple, red maple, black cherry, fire cherry, aspen, beech, and yellow birch.

It may be worth noting that the number of trees per acre, 15 years after the establishment of the plantation, is 1,541. Of these 553 only are planted stock, all softwoods. There are in addition 45 native red spruce and balsam, naturally reproduced. The striking thing to be noted is the invasion by natural reproduction into a prepared and planted site, of the great numbers of native hardwoods. These total 943, or 61 per cent of the numerical value of the stand per acre. The occurrence of a large number of aspen and fire cherry in this stand is of temporary consideration only, as they are expected to play but a small part in the future forest, whose typically mixed character seems already indicated.

The comparative numbers of trees planted were not determined with accuracy since several spacings were included in the study. Blue spruce was not planted in quantity. The presence of red spruce and hardwoods was general over the tract but more prevalent on approaching the timber belt mentioned. This condition, however, was avoided, as far as possible, by restricting the caliper record to the center of the planted area.

The preponderance of hardwood species, combined with their greater height in any given inch class makes the competition with the planted softwood very keen. Heights were taken at random over the plantation to get the relation of height to diameter for each species in each inch class.

The general impression created by the plantation and the compiled data, is that the method here used of clean cutting in its true sense with burning of brush has resulted in producing a *mixed hardwood and softwood forest*, and as such is successful. This does not answer, however, the problem of planting hardwood land as ordinarily cut for all merchantable species, nor does any other plantation thus far found in the Adirondacks. Even on this Wawbeek area subsequent treatment will demand the removal, at some future date, of these competing hardwoods, and only in that operation will the Fernow experiment of converting a pure hardwood and mixed growth forest into a pure softwood forest be completed.

TABLE 3.—*Height* in Feet by Diameter Classes for the Principal Species on 1904 Plantation, Near Wawbeek, Franklin County, N. Y., Measurements Taken July, 1919.*

Species	D. B. H. (o. b.) inch classes													
	1		2		3		4		5		6		7	
	Height in feet	No. of trees measured	Height in feet	No. of trees measured	Height in feet	No. of trees measured	Height in feet	No. of trees measured	Height in feet	No. of trees measured	Height in feet	No. of trees measured	Height in feet	No. of trees measured
Scotch pine....	8.75	20	11.65	20	14.25	20	14.80	20	18.70	20	19.95	20	21.75	4
White pine....	10.55	20	13.90	20	16.20	20	20.70	20	21.80	9	.....	....	.....	....
Norway spruce.	10.35	20	14.55	20	17.00	19	22.00	5	.....	....	.....	....	.....	....
Yellow birch..	14.20	20	16.85	20	21.55	20	.....	....	.....	....	.....	....	.....	....
Sugar maple...	13.10	20	19.25	20	21.25	14	.....	....	.....	....	.....	....	.....	....
Red maple.....	14.70	20	19.15	20	21.40	14	.....	....	.....	....	.....	....	.....	....
Black cherry...	13.85	20	19.50	20	23.05	20	25.30	20	.....	....	.....	....	.....	....

*Mathematical averages only; not curved.

It follows from the foregoing that a plantation established on cut-over land without other preparation, would develop an even more mixed character of composition, experience a greater degree of competition from native growth, especially hardwood sprouts and seedlings, and be more susceptible to an early and severe degree of suppression. This, therefore, would necessitate not one but perhaps two or even three supplementary cutting operations designed to remove the competing hardwoods before the design of achieving the desired kind of forest, in species and mixture.

SUMMARY

1. Spruce swamp areas lend themselves naturally to clear cutting methods with natural reproduction.
2. The delicate equilibrium exhibited by the spruce or balsam flat areas, their susceptibility to windthrow, and their high degree of liability to mortality from exposure, indicate the application of a modified selection system on a conservative basis.
3. Hardwood areas must be opened up to such an extent as will induce accelerated growth on the smaller sized trees remaining, after the cutting, without subjecting them to death through exposure. A secondary removal cutting in the second-growth forest is also indicated for the purpose of obviating subsequent stagnation from overtopping fast-growing, wide-spreading hardwood crowns.
4. The upper slope forests should be managed on the basis of the protective forest only.
5. Planting on burned-over areas should be undertaken before the native growth of weeds, ferns, and brush offers such competition to the planted stock as will induce very early stagnation and probable extinction.
6. Planting on cut-over lands gives little promise of success unless the area is given a preparatory treatment by burning for the purpose of clearing the site of native seedling and sprout growth. Even then a secondary silvicultural treatment will be necessary in order to remove competing fast-growing hardwoods subsequently seeded into the area.

BIBLIOGRAPHY

Graves, H. S. Practical Forestry in the Adirondacks. Bulletin 26, Division of Forestry, U. S. Department of Agriculture, Washington, D. C., 1899.

Chandler, B. A. Results of Cutting at Nehasane Park in the Adirondacks. Journal of Forestry, Vol. 17, 1919, pp. 378-385.

Linn, E. R. Silvicultural Systems in Spruce in Northern New Hampshire. Journal of Forestry, Vol. 16, 1918, pp. 897-908.

Baker, M. P., and McCarthy, E. F. Fundamental Silvicultural Measures Necessary to Insure Forest Lands Remaining Reasonably Productive After Logging.' Journal of Forestry, Vol. 18, 1920, p. 18.

McCarthy, E. F. Observations on Unburned Cut-over Lands in the Adirondacks. Journal of Forestry, Vol. 17, 1919, pp. 386-397.

Churchill, M. L. An Example of Private Forestry in the Adirondacks. Journal of Forestry, Vol. 17, 1919, p. 602.

Bryant, R. C. Silviculture at Axton and in the Adirondacks Generally. Journal of Forestry, Vol. 15, 1917, pp. 891-895.

Hawley, R. C. Forestry at Nehasane Park. Journal of Forestry, Vol. 18, 1920.

McCarthy, E. F., and Belyea, M. C. Yellow Birch and its Relation to the Adirondack Forest. Technical Publication No. 12, Volume 20, No. 1. Publications of the New York State College of Forestry, Syracuse, 1920.

SECOND GROWTH HARDWOODS IN THE ADIRONDACKS

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The increased cutting of hardwoods—beech, yellow birch, and hard maple—in the Adirondacks has emphasized the need for accurate information on the productivity of second growth stands of these species. Stump analyses of virgin stands gave results far below the actual increment of the young trees and hence were of little or no use in solving the problems of managing our northern hardwoods.

The tendency in managing hardwoods is toward clear cutting which produces conditions utterly different from those existing in the selection—form of forest that produced the mature trees of the present day. Clear cutting results in even-aged stands of beech, birch, and maple and in a more rapid growth in diameter height and volume as the figures on the following page show.

These figures were taken on typical hardwood land cut clear, 25 to 30 years ago, for fuel-wood for a nearby logging camp. The result is the fine, thrifty development of stands, preponderatingly hard maple and yellow birch, with a d. b. h. at 25 years, of better than 3½ inches, a total height of 45 feet (or a growth of nearly 2 feet per year!), and a volume of 22½ cords per acre or a mean annual increment of nearly a cord per acre per year! In order to have a check on the volumes they were abtained both by Pressler's and Schiffel's formulae.

The figures show the dense stocking per acre and point to the need of this in young hardwood stands. One-third of the trees that started have died, after contributing the benefits of their competition to the survivors.

The data presented herewith are purely preliminary but they point to a productive possibility in our second-growth hardwoods which is distinctly encouraging. As opportunity offers, this study will be continued until, if possible, a hardwood yield table can be constructed for the Adirondacks.

Summary of Data on Second Growth Hardwood Stands, obtained near Camp Cornell, Tupper Lake, N. Y.

(Based on six 1-10 acre plots measured September 14, 1920)

Species	Composition	Mean sample trees		
		D. b. h.	Height	Age
	Per cent	*Inches*	*Feet*	*Years*
Beech	15.8	4.1	46.3	26
Yellow birch	37.8	3.9	45.4	27
Hard maple	40.0	3.4	45.6	25
Miscellaneous (striped maple)	6.4			
Total	100			

Average number of trees per acre 1,750

Average number of living trees per acre 1,115 (64%)

Average number of dead trees per acre 635 (36%)

Average number of cubic feet per acre { Pressler[1] .... 1,998.14; Schiffel[1] .... 2,052.43 }

Average number of cords (at 90 cu. ft.) per acre { Pressler .... 22.2; Schiffel .... 22.8; Average .... 22.5 }

[1] The details of Pressler's and of Schiffel's formulæ will be found in Article 25, on page 46 of Recknagel and Bentley: "Forest Management," John Wiley & Sons, N. Y., 1919. In brief, the formulæ are:

$$\text{Pressler: } V = \frac{2}{3} B \times H \frac{1}{2} d$$

$$\text{Schiffel: } V = \left(\frac{1}{6} B + \frac{2}{3} b \frac{1}{2} \right) \times H$$

Where B=lower base; b $\frac{1}{2}$ =base taken at one-half the height; H=height; H $\frac{1}{2}$ d=height at which the diameter is one-half that at the base.

FOREST PLANTING IN SOUTHERN MICHIGAN[1]

By L. J. Young,

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The text of this paper is hardly so broad as its subject, since it is confined to the planting done by the Forestry Department of the University of Michigan in the vicinity of Ann Arbor.

Plantations were started within a year after the establishment of the department to increase the facilities for instruction, to afford opportunities for research later on and to serve as demonstration areas to the public. Since the university is located in a strictly hardwood region, the only way in which readily accessible stands of conifers could be had was by planting, so this sort of work was pressed rapidly during the early years. Hardwoods, however, have not been neglected but have received equally as much attention as the conifers.

In addition to lands owned by the university, much larger areas, belonging to the local power company, have been restocked with a variety of species.

Sowing methods have been employed only with a few of the nut trees and not even atttempted with conifers, since all early experiments along this line resulted in absolute failure.

The climate of this locality is not one that is conducive to an easy life for the young forest tree of any species when set out in the open amid unnatural surroundings. A mean annual precipitation of twenty-eight inches furnishes no great margin of safety, and when combined with an erratic distribution, that margin becomes still less. There is a tendency toward dry and rather hot summers. Little droughs of two or three weeks that are apt to come in May and early June are often especially provoking. In 1917, for example, there was no rain worthy of the name from the completion of planting in the middle of April until late in September. Long and severe winters occur every two or three years, often without a great deal of snow, so that the soil is frozen deeply. The change from winter to spring is usually a prolonged process with much alteration of cold nights and warm

[1] Read before the annual meeting of the Society of American Foresters, at New York, N. Y., December 20, 1919.

days, thus causing a great deal of frost heaving on wet and heavy soils. The soil shows all the usual variability of glacial drift, from sand and gravel to the heaviest clay, with hardpans often occurring within a foot or two of the surface.

On all of the better soils, a very heavy, tough sod soon forms, serving to increase costs and add to the difficulties of the trees in getting established.

The only enemies that have been at all serious are mice, rabbits and a few insects. Mice have caused a varying amount of damage, confined chiefly to red oak, sugar maple, chestnut, basswood, hickory, black locust, yellow poplar, Scotch pine, Douglas fir, Norway spruce, and western yellow pine. The only species that have been entirely free from this sort of damage are white elm and white pine. By 1917, mice had become such a pest that all areas of hardwoods and yellow pines were poisoned.

In the beginning, rabbits were a negligible quantity, but since the prohibition of hunting a few years ago, have steadily become more numerous, so that special measures of control are now necessary. Snaring in the winter has proven very effective.

Among the insects, the locust borer, the oyster shell scale on white ash, the larvæ of the June bug, and certain defoliators have caused the most damage.

During the first few years after planting, the borer threatened to ruin the stands of black locust, but within the last five years, the apparent damage from this source has decreased decidedly, and a good stand still remains.

Oyster shell scale became so bad on white ash as to force the clear cutting of all stands as a precaution against its spread to others of its numerous host species in adjoining stands.

The June bug did little damage in early plantings that followed closely upon the use of the land for agriculture. In recent plantings, however, they have in several cases caused the death of as much as three-fourths of the trees in the first summer.

Box elder, basswood, and white elm have suffered from time to time most severely from attacks of defoliators, though sugar maple, white ash, black walnut, and chestnut have also been damaged enough in this way to deserve mention. A few small spots of white pine have been stripped of foliage on three occasions by the sawfly. Tamarack has not been planted in stands, because of the prevalence of the sawfly.

The white pine is now infested to quite an extent with Chermes,

though no damage is apparent, as the enemies of Chermes seem to be holding it pretty well in check.

In addition to the scale, white ash has been badly damaged by a twig borer.

Climatic factors also have contributed their share to the quota of damage. A severe hail storm in 1916 caught the leaders of white pine, Douglas fir, western yellow pine and Norway spruce just at the period of rapid elongation and broke off from 10 to 15 per cent. A sleet storm in the following year caused heavy damage to white pine leaders, but very little in the case of other conifers.

Late frosts have killed back all new shoots at intervals of three to four years on Douglas fir, Norway spruce, catalpa, Russian mulberry, black locust, red oak, and white oak. The same frosts have killed the newest leaves on yellow poplar, white ash, and black walnut but without damage to the stems.

Severe winter killing has occurred only with catalpa, osage orange, and chestnut. Catalpa trees 14 years old were killed back to the ground during the winter of 1917-18.

Windfall damage has been limited to Scotch and Austrian pines, caused by a wind of unusual strength in November of last year.

All of the first plantings were established by first plowing and cultivating the areas thoroughly and then placing the trees in a slit made and closed with a spade. With one exception, these were highly successful, resulting in a catch of over 95 per cent.

On a few areas, squares of sod were stripped off with a grub hoe and the trees set in a slit made and closed with a spade. The soil was a heavy clay, and subsequent growth has been slow, though the catch was over eighty per cent.

On all the heavier soils, cultivation of the area has resulted in a dense stand of weeds for several years after planting, which not only interferes with the development of the young plants but incurs the hostility of neighboring farmers. As a result, all of the more recent work has been done with the grub hoe, stripping the sod from a sixteen-inch square and digging a hole, not a slit, for the plants. The catch with this method has varied from 50 to 95 per cent, the poorer ones being due, in most cases, to unfavorable site conditions and poor stock rather than to the planting method.

Sowing has been done in drills and seedspots. Drill sowing, preceded by cultivation of strips has been very successful with red oak.

Seed spots with red oak and black walnut have given good results, but with hickory have practically failed. It might be mentioned, however, that planting hickory has not been any more satisfactory on the sites where it has been tried.

In the first plantings of conifers, where the soil was cultivated, 2-0 stock was used throughout, but where the grub hoe method is used, stronger stock has been found necessary, especially on the heavier soils. The main trouble in these latter cases seems to have been the encroachment of the sod, resulting in a much lower catch and slower growth in the early years. As a result of our experience, the present practice is to use 2-2 stock with white pine, Norway spruce, and Douglas fir and 1-2 stock with Norway, Scotch, and western yellow pines. Unfortunately, the parallel plantings made with different ages of stock of the same species were placed upon privately owned lands and were allowed to run for a short time only. One case will illustrate the general trend of results obtained. Two plantings of white pine were established side by side on level ground with all conditions the same, except that one was started as 2-0 stock and the other as 2-2. At the end of two years, the 2-0 stock showed a catch of 52 per cent, the other 95 per cent; the average height of the 2-0 stock was five inches, of the other 18 inches.

All hardwoods have been started as one-year seedlings, except cottonwood, which was established by cuttings.

Spacings used have been 3x3, 2x4, 4½x4½, 5x5, 6x6, 7½x7½, 10x10. The 2x4 spacing was used only in seed-spot work; the 10x10 only with cottonwood. In a few cases parallel plantings have been made with the same species, using two or three different spacings. The results of these are already instructive.

Three areas of black locust were set in 1906 with spacings of 3x3, 4½x4½ and 6x6. Measurement of all the trees on these plots last year showed the growth to have been as follows:

Spacing	Average d. b. h.	Average height	Maximum d. b. h.	Maximum height	Basal area per acre
3x3	3.1	28.2	6.2	39.5	66.67
4½x4½	3.4	28.8	6.3	39.5	58 65
6x6	3.7	28.4	6.5	36.2	37.8

These figures represent the growth during 14 years after planting.

The present stand per acre in each case is as follows:

Spacing	No. trees per acre	Per cent of loss	Basal area per acre
3x3	1,222	75	66.67
4½x4½	925	57	58.65
6x6	508	58	37.8

Since the per cent of trees dropping out has been modified very considerably by the work of the borer, these figures can not be considered as normal.

A better example of the effects of spacing is furnished by two plots of white pine planted in 1904 with spacings of 3x3 and 4½x4½. Based on measurements made in the fall of 1920, the results have been as follows:

Spacing	Average d. b. h.	Average height	Maximum d. b. h.	Maximum height	Basal area per acre
3x3	2.7	20.8	5.3	30.3	141.34
4½x4½	3.3	21.8	6.2	33.8	118.74

The present stand per acre follows:

Spacing	No. trees per acre	Per cent of loss
3x3	3,377	30.3
4½x4½	1,945	9.6

The relative condition of the stands in the fall of 1916 is shown in the following table:

Spacing	Average d. b. h.	Average height	Maximum d. b. h.	Maximum height	Basal area per acre
3x3	2.3	17.0	3.6	20.9	99.67
4½x4½	2.5	16.0	4.8	24.8	75.00

The 1920 figures, showing the results of 17 years of growth, indicate clearly that most of the advantages lie with the wider spacing. The cost of establishment was about one-half that of the 3x3; the average height and diameter are now greater; the stand closed over only about two years later; and the individual trees have the branches shaded out

within one or two feet of the height to which they are killed in the more closely spaced stand; the loss of trees through suppression has been less than a third as great. So far, the stand with wider spacing has failed to equal the basal area of the other, but this difference will probably continue to grow smaller rather more rapidly than it has in the past, though, during the past four years, the stand with 4½-foot spacing has gained only two square feet over the other. The race between them from now on will be an interesting thing to watch.

In view of the fact that these stands are growing south of the natural range of white pine in this part of the state, it was to be expected that their development would fall below that of those found well within its original habitat. However, a comparison with the yield table for Quality I white pine in New Hampshire, given on page 21 of the bulletin, "White Pine Under Forest Management," by E. H. Frothingham, shows that such has not been the case, especially with the 4½-foot spacing. If values for the age of 17 years are computed by interpolation from Frothingham's figures, they run as follows:

	New Hampshire stand	Michigan stand
Average height	18.5 feet	21.8 feet
Average diameter	3.34 inches	3.3 inches
Basal area per acre	86.8 square feet	118.7 square feet
No. trees per acre	1,441	1,945

The figures for average height are not exactly comparable, since those for New Hampshire are the average for dominant trees only, while those for Michigan are for all the trees in the stand. The character of the soil in this case makes these results even more surprising, since it is composed largely of sand and had been badly worn out by a long period of wasteful agricultural use. Its one virtue lies in its generous depth.

In all cases up to the present stage of development, the conifers planted, intolerant as well as tolerant, have demonstrated their ability to produce and maintain good forest conditions in pure stands. Ground cover of all sorts disappeared as soon as the stands became closed, and a good forest floor has been formed. These conifers include the Scotch, white, Austrian, and western yellow pines, Douglas fir (Rocky Mountain form), and Norway spruce. (All attempts to grow stock from Pacific Coast seed of Douglas fir have failed because of winter killing, even in winters that are unusually mild for this locality.)

On the other hand, all of the intolerant hardwoods planted have lacked this ability. With the exception of black locust stands during a short period immediately after their closing, stands of these species have a heavy ground cover of grass, and, consequently, no forest floor. These species include white ash, white elm, white oak, catalpa, and Russian mulberry. Stands of other intolerants, red oak, osage orange, hickory, chestnut, black walnut, and cottonwood have not yet closed, so no positive statement concerning them in this respect can be made, though a small part of one sowing of black walnut on exceptionally good soil shows the ground cover entirely driven out. This condition will probably be temporary, as it was with black locust. Yellow poplar has been planted only in mixture with white pine, so we have no demonstration of what a pure stand would do.

Basswood, a medium tolerant here, will probably make a better showing when the stand closes.

After making a very promising beginning, considerable portions of pure stands of white elm and white ash seem to have stagnated.

Throughout a strip immediately adjacent to a stand of black locust, box elder has made excellent growth and has succeeded in eliminating ground cover, though no forest floor has accumulated. This particular stand furnishes a striking illustration of the beneficial effect of black locust upon soil. Sugar maple is the only hardwood of high tolerance planted and has run true to form in maintaining an excellent soil condition.

Catalpa, chestnut, and osage orange have shown conclusively that they have no real place here. Russian mulberry has developed into nothing more than a lot of scrubby brushes. Better soil or a mixture with other species might make something out of it.

In addition to those already listed, other species in small groups that have made thrifty growth are jack and Norway pine, blue and white spruce, eastern balsam, concolor fir, hemlock, honey locust, horse chestnut, buckeye, cucumber, arbor vitæ, tamarack, European larch, European alder, sycamore, silver maple, white birch, and coffee tree.

On the basis of average annual growth in height and diameter, Scotch pine still leads all of the conifers with white and Austrian pine a close second and Douglas fir, western yellow pine, and Norway spruce in the order named. The relatively poor showing of Norway spruce is largely due to its location on a poor spruce site.

Among the hardwoods, cottonwood ranks first with sugar maple second and the other species in the following order: Box elder, white

elm, yellow poplar, red oak, catalpa, white ash, white oak, black walnut, Russian mulberry, basswood, osage orange, chestnut, and hickory. However, a large part of the differences in growth is undoubtedly due to soil variations rather than to inherent differences of the species themselves. In determining the above order, the growth made by the best stand of each species was used. Red oak furnishes an illustration of the variability in soils. Several stands of this species of nearly the same age are located on various parts of the area. In these stands, the average annual height growth for the whole life of each one ranges from 0.43 of a foot to 0.92.

The details of the growth made by each stand up to the time of the last measurement (complete measurements are made at five-year intervals) are shown in the following table:

Species	Age, years	No. trees per acre	Original spacing, feet	Average d. b. h., inches	Average height, feet	Maximum d. b. h., inches	Maximum height, feet	Total basal area per acre, sq. ft.	Average annual growth	
									D. b. h., inches	Height, feet
Scotch pine.......	17	1,800	4x4	3.6	25.7	7.7	41.5	127.8	0.21	1.51
Scotch pine.......	14	....	irreg.	2.5	21.1	5.9	33.0	....	0.18	1.51
White pine........	17	3,377	3x3	2.7	20.8	5.3	30.3	141.3	0.16	1.22
White pine........	17	1,945	4½x4½	3.3	21.8	6.2	33.8	118.7	0.19	1.28
Austrian pine.....	14	2,244	4x4	2.9	17.9	5.2	24.7	104.9	0.20	1.28
Douglas fir.	14	1,138	4x4	1.3	11.1	2.8	17.2	9.321	0.09	0.79[a]
W. yellow pine....	11	825	6x6	1.3	7.6	3.1	13.9	8.258	0.12	0.69
W. yellow pine....	14	....	irreg.	1.6	10.9	4.8	18.7	....	0.11	0.78
Norway spruce...	15	3,188	3x3	....	6.5	......	21.1	....	....	0.43
Cottonwood	5	207	10x10	0.8	9.7	1.7	15.2	.621	0.16	1.94
Sugar maple......	12	2,750	4x4	1.3	14.0	2.6	21.8	25.98	0.11	1.16
Sugar maple......	12	1,555	5x5	1.4	13.9	3.5	20.6	17.04	0.11	1.16
Box elder	12	1,081	6x6	1.2	11.4	3.2	22.0	0.55	0.10	0.95
Box elder	12	2,203	4x4	1.2	13.2	4.0	26.8	18.66	0.10	1.10
White elm	12	....	5x5	1.4	12.8	3.8	24.0	....	0.12	1.07
Yellow poplar....	14	928	4x4	1.5	15.0	3.0	22.4	12.10	0.11	1.07[b]
Red oak...........	14	1,026	4x4	0.8	8.4	2.6	17.9	3.96	0.057	0.60
Red oak...........	12	1,019	5x5	....	6.6	......	16.7	....	....	0.55
Red oak...........	12	308	6x6	....	5.2	......	13.7	....	....	0.43
Red oak...........	12	573	5x5	0.8	8.6	2.3	15.4	3.822	0.066	0.71[c]
Red oak...........	12	680	5x5	0.9	9.1	3.0	19.6	6.170	0.075	0.76[d]
Red oak...........	12	522	6x6	0.7	8.6	2.1	16.2	9.31	0.06	0.71[e]
Red oak...........	13	980	6x6	0.8	8.1	2.2	17.2	3.712	0.06	0.62
Red oak...........	13	829	6x6	0.6	7.1	2.8	16.4	2.261	0.05	0.55[f]
Red oak...........	12	526	6x6	0.9	11.1	2.4	17.6	2.456	0.075	0.92
Catalpa	14	1,884	4x4	1.5	11.7	6.7	31.1	24.16	0.11	0.83[g]
Catalpa	13	2,780	4x4	1.4	11.6	3.6	18.6	30.58	0.11	0.89
Catalpa	15	2,218	4x4	1.3	10.5	4.1	22.5	31.096	0.09	0.70
White ash.........	12	1,200	6x6	....	7.1	......	15.9	....	....	0.59
White ash.........	14	2,500	4x4	1.1	11.7	2.3	19.0	17.500	0.08	0.83
White ash.........	13	1,100	6x6	1.3	11.4	3.3	22.3	9.700	0.10	0.87
White oak	13	1,717	4x4	....	8.1	......	15.5	....	....	0.62
White oak	11	839	5x5	0.2	4.8	0.7	9.4	0.168	0.018	0.44
White oak	14	671	5x5	....	3.7	......	11.2	....	....	0.26
Black walnut.....	11	606	5x5	0.4	6.1	1.4	10.1	.545	0.036	0.55
Black walnut.....	14	2,085	5x5	....	5.8	......	11.9	....	....	0.41[h]
Black walnut.....	8	550	2x4	....	4.7	......	8.1	....	....	0.60[i]
Russian mulberry	13	1,887	4x4	....	7.8	......	17.7	....	....	0.60
Basswood	13	1,701	4x4	0.8	7.2	3.1	16.3	5.920	0.06	0.55
Osage orange.....	15	2,205	4x4	....	6.3	......	20.3	....	....	0.42
Chestnut	14	128	6x6	....	4.9	......	9.3	....	....	0.35
Hickory...........	10	120	4x4	....	2.6	......	6.0	....	....	0.26

a Now mixed with *P. ponderosa*. b Mixed with white pine. c Seed spot in fall. d Seed spot in spring. e Seed spot in spring. f Seed spot in spring. g Mixed with Scotch pine. h Seed spot in fall. i Seed spot in spring.

SOME INSTANCES OF SAND DUNE PLANTING

By C. R. Tillotson

On my trip during the summer of 1920, I ran across a couple of instances of sand dune planting which it will be well to put on record.

SAND DUNE PLANTING, CAPE COD, MASS.

Near the town of Provincetown, Mass., at the extreme tip of Cape Cod, the State owns 3,290 acres af land all of which will eventually be reforested unless present plans are changed. The soil is a very coarse white sand which supports in protected places a natural growth of pitch pine (*Pinus rigida*), and in the more moist locations the low bushy bayberry. A considerable amount of reforestation has already been conducted under considerable difficulty. It may be said that during the winter terrific wind velocities are experienced here, and the movement of sand is mostly confined to that period. Up to the present about 100 acres have been set out to pines, largely the pitch pine, but a considerable amount of Scotch and Austrian and a little red pine has also been tried. The native pine is dug in the surrounding territory. Two men dig the trees, two handle them in carts, and two plant. These six men working in this manner handle about 1,000 trees per day. The trees are dug so as to leave the sod and earth about one foot square around the roots. Before trees are set out on the land, it is first covered with brush cut from native pine. The cost of cutting raw and covering an acre varies with the distance, but averages about $20 per acre at present when the wages are $3 per day. After this brush rots down the areas are planted with pine with very good success up to the present time. I saw some Austrian pine, set 14 years ago, which is now 18 feet high. Scotch pine on a very exposed site appears fully as, if not more, vigorous than Austrian pine. Scotch pine set 7 years is about 7 feet high in the more sheltered locations and grades down to about 3 feet on the most exposed situations, such as a northwest slope. On the very top of one such northwest slope Austrian pine is planted, much of which is scrubby. It varies from 2 to 3 to 7 and 8 feet tall. Considering the situation, however, I should say it has done wonderfully well.

The native bayberry has also been planted extensively on these lands. It is dug in the swamps, transported in carts to the planting areas,

and transplanted direct on the bare sand without any preliminary covering of the area with brush. The younger bayberry plants about 12-14 inches tall have been found to be best for this work. They are set out about 18 inches to 24 inches apart. The work is begun at the bottom of the slopes and carried on upward. It is useless to begin at the middle or top of the slopes because the sand blows out and undermines the plant. Mr. Chase, who has been in charge of the work, prefers to plant bayberry in the fall, while spring is preferred in the planting of pine. Pine, by the way, is spaced about 4 by 4 feet.

Mr. Chase has had some luck in planting Scotch broom. It sprouts from the roots and is taking hold in some places. He claims that the transplating of beach grass is unsuccessful here since, when transplanted, it does not live more than 2 or 3 years. If it bears seed in the meantime, however, and this seed catches on the area, the resulting stand of beach grass grows nicely.

SAND DUNE PLANTING NEAR HARLEM, MICH.

This particular section of the country lying just to the east of Lake Michigan is very sandy, and, in addition to immense dunes which border the shore of the Lake, there are small interior dunes which give farmers considerable trouble. The particular dune which I saw near Harlem is only 4 to 5 acres in extent. Last fall (1919) white pine, white spruce, western yellow pine, and Scotch pine were planted on the dune, but from present appearances are not going to be successful. The fall is a very poor time in the first place to set out trees on sand dunes. The worst winds occur in the winter and the sand moves to the greatest extent during that time. As a result many of these trees which were set out last fall have died because the sand has been torn away from around the roots. Some, however, have taken hold and may succeed. A better showing has been made by beach grass and by a combination planting of willow and cottonwood, the willow being placed to the windward. Two species of willow were used, the purple and the American green. The purple willow has not proved nearly as good as the American green. It does not throw out any branches, and what is needed in this kind of planting is something which will branch profusely. The American green has proved a little better in this respect than the purple willow, but I do not believe it is at all ideal. The combination of willow and cottonwood gives promise of holding the sand. What is really needed in this sand dune planting is an evergreen which, of course, will hold its leaves in the winter and lie rather flat on the sand. This would prevent the wind scooping the sand out and carrying it away during the winter months.

NOTES ON SLASH DISPOSAL IN THE LAKE STATES

By J. A. Mitchell

Forest Examiner, U. S. Forest Service

Advantage was taken during a recent field trip of the opportunity offered to look into the matter of slash disposal in the Lake States and to discuss the subject with the men in charge of the work.

WISCONSIN

In Wisconsin, the Government operation on the Menominee Indian Reservation, where brush piling and burning has been in effect for some time, was visited. Here the manager in charge very kindly showed me around and opened his records for my inspection. His woods foreman, a practical north woods logger, also was interviewed and his whole-hearted endorsement of brush piling as a matter of good logging practice was most convincing. As a matter of fact, it has here been demonstrated beyond a doubt that slash disposal in the hardwood-hemlock type of northern Wisconsin properly handled is a paying proposition wholly aside from its desirability as a matter of fire protection.

Briefly, the method followed is to fall the hemlock, piling the brush as the trees are trimmed, and then to fall the hardwoods on top of the hemlock brush piles, the operation being completed by trimming off small limbs and the tips of larger limbs under two inches, piling the resulting hardwood brush on the hardwood and hemlock tops. This results in large but fairly compact piles that, because of their foundation of hemlock brush, burn readily and fairly clean. Burning is done in the spring after logging as early as conditions allow, preferably while snow is still on the ground. While perhaps not ideal in every respect, the result in general is highly satisfactory for the slash is effectively eliminated as a fire menace, and the damage to the young growth remaining is minimized, as less than one-half of the area is burned over.

The secret of the success of slash disposal in this case is:

(1) The recognition of slash disposal as a part of the logging operation.

(2) Close utilization.

(3) Efficient methods.

(4) Cooperation on the part of the men.

The manager in charge of the operation puts the last first, for, as he points out, unless those who do the work are willing to give it a fair trial it is useless to expect satisfactory results. He stated that his greatest difficulty had been to overcome the ingrained prejudice of the men toward the idea of slash disposal, but that once the foremen had been won over and their cooperation secured, the work had proceeded smoothly and satisfactorily.

But it is also fundamental that slash disposal be recognized as a part of the logging operation for handled separately it is expensive and often impracticable. In the operation under consideration, however, it has been found not only to be practical, but to more than pay for itself, (*a*) in reduced skidding costs, (*b*) in the saving of horse flesh, and (*c*) in logs otherwise overlooked and left in the woods. In support of the above the logging boss is authority for the statement that where, under ordinary logging methods, two swampers are required to a team only one is needed where the brush is piled, while often one can do the work for two teams. This saving alone, it is claimed, offsets the increased cost of cutting and trimming, with which operation brush piling has been combined. The saving under (*b*) and (*c*) has not been figured out, but is said to be considerable. Other reasons given for making slash disposal a part of the logging operation are that the additional trimming necessary can be done at minimum expense at the time the rest of the tree is lopped; that the brush can be handled best when green and cheapest when first taken from the tree; and that rehandling is avoided and the brush is gotten out of the way of the sawyers and skidders.

Close utilization, also, contributes materially to the success of slash disposal by reducing the additional trimming necessary to a minimum and eliminating much of the heavier logging refuse. But, on the other hand, slash disposal contributes to closer utilization, for where tops are closely trimmed and the brush is piled much merchantable material is salvaged that would otherwise be left in the woods.

Efficient methods also are an important factor, as slash disposal costs can be materially reduced by a little head work. In the present case the outstanding efficiency features of the methods developed are:

(*a*) Piling the brush as it is cut—because of the greater ease of handling, to avoid rehandling, and to get it out of the way of future operations;

(*b*) Falling and piling the hemlock brush first—to make a foundation for the piles that will insure a clean burn;

(*c*) Falling the hardwoods on top of the hemlock brush piles—to avoid handling the heavy hardwood tops (another argument for combining brush piling with logging); and

(*d*) Burning the piles in the spring while snow is still on the ground—to avoid the risk of fire and to reduce the damage incident to brush burning.

By skidding the hemlock before the hardwoods are felled and burning the brush piles before skidding the hardwood, it was believed that the logs could be gotten out still cheaper. As yet, however, this plan had not been tried out.

The operation in question is in a typical hardwood-hemlock stand, consisting of 40 to 50 per cent hemlock, 10 to 20 per cent pine, and the balance hardwoods in which maple, birch, basswood, and elm predominate. The stand averages about 12,000 feet per acre and the logs run about 13 to the thousand. Practically clean cutting is being practiced and close utilization is insisted upon, the hemlock being cut to 8 inches for logs and 4 inches for pulp, while the hardwoods are cut to 6 inches and logs as short as 8 feet are taken out. The work for the most part is let out to jobbers on a piece-work basis, although one or two camps are run where the men are hired by the day. On a piece-work basis 18 cents was paid in 1920 for cutting (including felling, trimming, and brush piling) for logs 16 feet and over, and 14 cents for logs 14 feet and under. On the same basis 7 cents and 5 cents are paid for pulpwood. The skidding, loading, etc., is either let as a separate contract or handled by day labor. In 1919 the average cost at the track for logs was \$7.14 per thousand, including brush piling, for 1920 \$9.90 per thousand, the increased cost being due to general wage increases in all lines of woods work.

Another item of interest is the requirement that all snags over 10 feet high be cut. For this work the men are paid 25 cents per snag, or where the snag contains two merchantable logs, 35 cents. This prac-

tice, inaugurated as a matter of fire protection, has been found to practically pay for itself in material salvaged, it being estimated that not over \$50 ta \$75 had been paid out for dead work in this connection in the two years the requirement had been in force.

When asked if the method of slash disposal being practiced would be applicable to the more open stands of nearly pure hardwood found in other parts of the State, the logging boss assured me that it would but that as clean a burn could probably not be secured owing to the absence of hemlock brush in the piles. He stated, however, that piling would be equally desirable as a matter of logging practice and that while the heavier limbs would probably not be consumed the smaller ones that constitute the extreme fire hazard the first few years after logging would be eliminated. When asked as to the probable increase in cost in view of the larger tops to be handled, he said that by proper falling handling could be largely eliminated and that it should not cost any more.

MINNESOTA

In Minnesota, conditions and opinions vary, but it is generally conceded that slash disposal is essential to effective fire protection. This does not mean brush piling and burning in every case, nor does it mean that the present practice of slash burning is generally satisfactory. In fact, it has been found that no one method of slash disposal is universally applicable. Certain principles, however, have been established that appear to be more or less fundamental. Briefly stated, these are as follows:

(1) Slash disposal by running fire is a failure, except where the land is to be immediately cleared or seeded to grass or where even-aged jack pine is cut clean and burning is done before the cones have had a chance to open.

(2) On pine and hardwood lands the slash should be piled and burned preferably at the time of logging.

(3) Intensive fire protection for a period of years is recommended in the case of spruce and cedar instead of slash disposal.

In addition, the following fire protection measures are advocated:

(1) Clean burning of slash as made: (*a*) Along roads and railroads; (*b*) around improvements, clearings, landings, skidways, portable mills, etc.; (*c*) around green timber; and (*d*) around all cuttings on which the slash is not disposed of.

(2) Falling of all snags, stubs, and dead timber.

(3) Gates in all drainage ditches so that the water can be backed up in case of a ground fire.

(4) Steel or concrete culverts.

(5) Burning permits.

(6) Speeder patrol in dry weather in addition to satisfactory spark arresting equipment on all railroads running through timber or brush lands.

The reasons given for declaring slash disposal by running fire a failure are that:

(*a*) When dry enough to get a clean burn it is too dry to burn with safety.

(*b*) Unless a clean burn *is* secured the fire hazard is increased by the addition of fire killed reproduction, brush, and standing timber to the slash remaining and by a rank growth of fire weed.

(*c*) Advance reproduction and seed stored in the duff are destroyed and the re-establishment of a forest cover delayed.

(*d*) It tends to eliminate, temporarily at least, the more desirable species, especially conifers, and to encourage the establishment of less valuable species and brush.

(*e*) It is impracticable since suitable conditions for a clean burn are usually of short duration and are of uncertain occurrence while variations in topography render uniform or satisfactory results impossible on any considerable area.

Piling and burning in pine and hardwood is advocated because it has been demonstrated to be practicable and, if properly done, reduces the fire hazard materially besides making it possible to control fires that may occur.

Intensive protection for a period of years instead of slash disposal in cedar and spruce is advocated because destroying the logging refuse does not materially reduce the fire hazard owing to the accumulation of forest litter normally present and the customary close utilization of these species for pulp and posts, while burning even where the brush is piled tends to increase the fire hazard by adding fire-killed reproduction and immature timber to the unburned slash and accumulated litter, and by exposing the soil to the drying action of sun and wind. On the other hand, if fire is kept out, advance reproduction and immature timber are saved, further reproduction is encouraged, and with the re-establishment of a forest cover decomposition is stimulated and

the hazard is soon reduced to normal. Another argument for not burning in the cedar and spruce types is that the soil being largely organic is damaged if not completely destroyed by any fire severe enough to materially reduce the fire hazard.

Much good has been accomplished by the Minnesota slash disposal law, but the results secured have undeniably fallen far short of what is to be desired in this direction. The reasons for this are:

(*a*) Failure of the law to recognize the public interest in the protection of second growth, its purpose being solely the protection of life and property.

(*b*) Lack of funds and organization for its enforcement. Three things, however, have been demonstrated, namely:

(1) That in the Lake States at least a compulsory slash disposal law is not only necessary and desirable but practicable.

(2) That its administration, however, must be flexible, as no hard and fast rule can be laid down; and

(3) That adequate funds and a trained personnel must be provided for its enforcement.

There are those who do not believe that hardwood slash disposal is desirable and silviculturally they may be right. Considering the extreme fire hazard created in the Lake States by hardwood slash, however, and the practicability and effectiveness of slash disposal by piling and burning as demonstrated in Wisconsin, it would appear to be desirable as a choice of evils at least until adequate protection by some other means is provided.

The above observations and conclusions are not the result of any special or exhaustive study and so are not necessarily conclusive. They are offered, however, as of general interest and as possibly throwing some light on the perplexing subject of slash disposal.

CONNECTICUT'S FOREST PROGRAM[1]

By T. S. Woolsey, Jr.,

Consulting Forester

At a special meeting of the Connecticut Forestry Association, a program for the future was proposed as follows:

1. Purchase by the State during the next ten years of at least 100,000 acres of forest (about one-tenth the total potential forest area and one-fifteenth the total gross area) to be organized and administered as State forests for the continuous production of timber. An initial appropriation of 50,000 by the General Assembly of 1921 is to be asked for.
2. Reorganization of State Forester's office.
3. Publicity on the rapid exhaustion of forest resources.
4. A revised tax law under which standing timber should pay a products tax at the time it is cut and the soil an annual land tax based solely on the value of the land apart from the timber.
5. That the County Farm Bureaus should give advice on the growth, management, and marketing of forest crops.[2]

With the industrial liquidation and deflation which is confronting the New England states and the consequent need for economy and retrenchment in public expenditures any forestry program which diminishes the current revenue and increases appropriations will naturally be difficult to engineer. But the situation is a serious one and demands drastic reform. The appropriation would be largely an investment and not an administrative cost.

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[1] Based on committee reports and resolutions read before a meeting of the Connecticut Forestry Association at Hartford, November 27, 1920. Connecticut Timber Supply, by R. C. Bryant, Chairman; State Forests, by W. O. Filley, chairman; A New Forest Tax Law for Connecticut, by H. H. Chapman, chairman; Cooperation Between the Private Forest Owners and the Public, by P. P. Wells, chairman; Forest Fires, by A. E. Moss, chairman.

[2] It is of interest to note that the association also voted to stop the commercial exploitation of the National Parks. Land chiefly valuable for commercial purposes should be placed under national forest management and administered as National Forests.

THE SITUATION

Notwithstanding the fact that Connecticut was the first State in New England to have a State Forester (1901) and one of the first to purchase State forest land, it is today one of the most backward. The facts are as follows:

State.	*State forests.*	*Remarks.*
Connecticut	4,277	No definite provision for future purchases.
Massachusetts	22,000	Act passed in 1920 to buy and reforest 100,000 acres during next 15 years at total cost of not to exceed $3,000,000.
Vermont	20,000	
New Hampshire	12,000	
Maine	......	In 1919 $15,000 appropriated for purchases of forest lands.

Less than one-half of one per cent of Connecticut's forest land of 1½ million acres is under forest management.

1. As a result of her decreasing forest resources R. C. Bryant states: (*a*) Hardwood sawtimber will be exhausted in 15 years; white pine in 12 years. This prediction is based on the present estimated stand of white pine divided by the production figures of 1918; but for the hardwoods it is an estimate. Probably the date of exhaustion will be slightly later than predicted because of the timber that is now immature that will become merchantable, and because of closer manufacture; but these factors may be discounted by more rapid depletion of local stocks because of the increased cost of imports, although present figures indicate a decreasing scale of depletion owing to a diminishing cut. (*b*) Connecticut consumes 305 board feet per capita and produces but 51. Lumber production decreased 50 per cent from 1910 to 1918. (*c*) The annual bill to the railroads for freight on forest imports is $3,000,000. This represents 6 per cent on an investment of $50,000,000. How much better it would be to have such an investment in growing forests rather than in freight bills!

If Connecticut could raise its own raw timber this annual expenditure for freight would be paid to local timber owners and mill men. Probably there would be but little net saving to the forest industry for the better grades of lumber, but undoubtedly lower grades could be substituted for imported products thereby effecting a saving. But the

drain on Connecticut capital will be increasingly great as the source of the raw product becomes more distant. Without local timber a great many forest industries must liquidate or move near their raw supplies. (*d*) According to Bryant 86 per cent of Connecticut's forest land could produce annually 375 million feet of lumber or *enough to supply present needs.*

There is another factor which must not be overlooked. At present there is a concentration of population in the towns. During periods of depression this results in having a large idle population. How *much better it would be to have part of this working population living in the country districts as permanent forest and forest industry workers.* England had in mind just such an advantage when she undertook her project of reforestation.

2. From the silvical standpoint the loss through the chestnut blight has been serious because in the past ties, posts and poles, and rough construction material came largely from local forests. As in Europe, cordwood (usually cut from coppice) is already grown to excess. Therefore much of the coppice area must eventually produce timber. Such an investment requires public ownership. For the very reason that large areas are in small private woodlots, public purchase and management will be a difficult undertaking and should be largely confined to forest areas as contrasted with woodlot areas.

3. The private forest owner has three main grievances at present, (*a*) uncertain and burdensome taxation, (*b*) inadequate fire protection, (*c*) lack of technical assistance. It is likely, however, that under (*c*) the demand for even free assistance would be nominal. Such technical assistance to be effective must be educational, and largely *demonstrated in the forests.* In France for example the woodlot owner sees proper technique demonstrated on nearby communal and state forests.

A questionnaire sent out by the Committee on Co-operation gave rather discouraging results. There seemed to be little inclination to turn lands over for technical treatment. The owners wanted to retain their own initiative of control and management. The committee suggested a number of possibilities: a paid secretary to organize the forest propaganda, co-operation of farm bureaus with forest owners, long term public management of private forests or a benevolent semi-public agency to take over private timberlands and manage them in the interest of the owners.

DISCUSSION OF THE PROGRAM

The remedies and solutions for the situation described have not as yet been definitely decided upon, but the tentative proposals are worthy of further comment.

1. *One hundred thousand-acre forest during next 10 years.* Such a purchase policy involving the expenditure of $50,000 the first two years is more than the program for Massachusetts (100,000 acres in 15 years). It will probably be difficult to carry the Connecticut purchase through in 10 years but the area aimed at is certainly conservative. The main difficulty will be the small holdings and the fact that such a large proportion of the forest land is really a part of the farm woodlot. It will be next to impossible to consolidate holdings without paying too high a price, and without consolidation administration will be dfficult. But the project can and should be carried out.

2. *Reorganization.* The new State Forester and assistant will head a State forestry department under the State Park Commission who shall make the appointments. The present forester for the Experiment Station will be a member of the State Park Commission but will specialize on research forestry. The State Forestry Department will then acquire and administer State forests, direct fire protection through the fire warden service, enforce State forestry statutes, co-operate in management of other public and private forest properties as directed by law. The State Park Commission is a strong non-partisan commission composed of able men and there is a precedent of having a State forestry official who is not appointed by the Governor; the present forester is appointed by the Experiment Station. It is doubtful, however, if the new State forester should give advice to private timber owners; this should be given by the Experiment Station Forester who, according to Filley, would be left "free to develop those lines of work . . . for which it was instituted, that is, investigational and experimental work in forestry; advice and encouragement to land owners; educational work along forestry lines."

There have been some interesting problems of organization in connection with the proposed reorganization. In the reorganization it is proposed to place the forester of the Agricultural Experiment Station on the Park Board. The new State Forester will then be appointed by the Park Board and work under that Board. The advantage of this scheme is that the Park Board will have the benefit of the advice and

experience of the present State Forester who will become forester for the Agricultural Experiment Station after the reorganization. The new State Forester will be appointed by a non-partisan board. In many ways the plan is logical. The main disadvantage is that it places the new State Forester in a position somewhat subordinate to the Agricultural Experiment Station Forester. His position will be similar to the Superintendent of Parks who reports to the Park Commission. If the new State Forester is to be a broad man of marked ability, it is doubtful if such a man would relish the position of State Forester under the proposed plan. On the other hand, if the new State Forester were a member of the Park Board he would vote on his own dismissal *unless the law provided he would not sit with the Park Board when the dismissal, resignation or appointment of a State Forester was under consideration.* The President of most companies is a member ex officio of the Board of Directors. So it is a pity not to see the State Forester a member of his governing board. The interests of forestry in the State of Connecticut would surely be strengthened by the proposed reorganization in whatever form it finally takes, but probably the best results would be secured by having both the State Forester and the Agricultural Experiment Station Forester on the Park Board if that board is to direct forestry in the State. With the State Forester off the Park Board it is conceivable that there might be a lack of administrative co-ordination when the Park Board was acting on park purchases in the absence of the State Forester. It is an interesting problem that probably will be solved by putting most weight on the personal equation rather than on purely administrative considerations. It will be of interest to see if there is a move to place the appointment of a technically trained State Forester in the hands of the Governor.

An important feature of the reorganization is the proposal to modify the present forest fire warden system which, according to the Committee on Forest Fires, is not proving a success because it is based on the town as a unit. Under the present system the town selectmen appoint a town fire warden and the State Fire Warden (the forester) "may appoint patrol subject to the approval of the State warden." Labor for fire fighting is ultimately paid for as follows: One-quarter by town, one-quarter by county, one-half by State. Lookouts are paid for by Federal funds. The objections to the present system are:

(*a*) Indifference of selectmen and changing of personnel. Low wage scale. Conflict of authority near town lines. Lack of time to

supervise fire protection on part of the forester. (*b*) Lack of proper equipment and no funds for lookout towers.

There is needed a reorganization along the following lines: (*a*) The town as a unit should be eliminated. There should be a State fire warden and three deputy wardens appointed by the Forester, at least 20 permanent lookouts and personnel to detect fires. (*b*) There should be a recommendation and study of the railroad fire problem; education of the public by all publicity means. Better disposal of slash at danger points.

3. New tax system to provide yearly land tax and severance tax on timber when cut. The detailed changes in the tax law proposed have been presented to the Connecticut Forestry Association but are as yet subject to revision.[3]

These tax reform proposals carefully thought out are an advance over anything that has yet been suggested but are open to objection on the following grounds: (*a*) Much of the wood land in Connecticut is already taxed on about the same basis as open bare land so the severance tax would be an additional charge on the owner. (*b*) The sliding scale to be applied to the timber cut would encourage cutting on too short rotations and involves complications where land is cut over twice during the periods named. (*c*) The determination of average stumpage rates for each county would be burdensome and complicated, and can be simplified. (*d*) The licenses for timber cutting would be difficult to check unless under State inspection and the lien should therefore be on the land owner rather than on the company that does the cutting.

Taken as a whole the proposed law seems to involve considerable complication and therefore would be difficult to work into the tax machinery of the State.

If a State constabulary is established in Connecticut at an annual expense of $200,000, certain phases of State fire protection may be placed under this body; the result would be uncertain.

It will be interesting to see whether the legislature places forestry under the State Park Commission. If this is done will forestry be relegated to the background with the proposed appropriation of $500,000 for forest parks and only $50,000 for lumber-producing forests? Can the two be combined? It is of interest that the Western Forestry and Conservation Association has recently recommended forestry commissions for Western States each composed of a member of each legislative house, *the State Forester*, State land commissioner, member Western Forestry and Conservation Association, and a member of the State forestry school.

[3] H. H. Chapman desired to revise the tax scheme before publication.

INCREASING FREIGHT RATES AS A COST IN MANUFACTURE

By Austin F. Hawes

Field Secretary and Forester, N. A. W. T.

The ramifications of the railroad situation and the increasing freight rates are so intricate that it is difficult to foretell what changes they may bring about in manufacturing methods. They will force the manufacturer, for one thing, to be more exacting as to the material on which he is to pay freight. In other words, the process of manufacture which is carried on near the woods will probably be carried farther. Increased freight rates will result in a tendency in our national industrial development exactly opposite to that, which has prevailed for the past few decades, and has resulted in the rapid growth of our great cities.

The development of local plants near the woods to carry on the first stages of manufacture, and utilizing, in many cases, electricity, developed from local water power, will be a logical result. In fact some of the large paper companies are already considering the establishment of small pulp mills near the woods.

Examples of the rise in freight rates as affecting the turning industry are the following increases on lumber from points in Maine to points in Rhode Island. A rate of 20 cents per 100 pounds was increased to 31 cents, and a rate of 25 cents to 35 cents. As applied to white birch squares, which weigh about 4,000 pounds per thousand, these increases were from $8 to $12, and from $10 to $14 per thousand. The tax amounting to about 40 cents per thousand has to be added to these rates.

The following table illustrates the range of freight charges at present rates:

	Cents per 100 lbs.
Points in Maine to Providence..................	31 to 35
Sault Ste. Marie, Mich., to Chicago..............	23½
Points in Arkansas to London, Ont..............	50½

Where the material to be manufactured can be shipped in the form ready for manufacture, the freight charge is not so excessive, but if

waste is included it becomes a serious factor. Thus where round edge white birch lumber is shipped to be made into squares for turning it requires about 1,000 feet of plank weighing 5,000 pounds to make 850 feet of squares weighing 4,000 pounds per thousand. In other words, it requires 5,850 pounds of plank to make 4,000 pounds of usable material, and the freight paid is therefore nearly 50 per cent more than where squares are shipped. On a rate of 30 cents, this makes an increase of from $12 to $17.55, or $5.55 per thousand feet of squares.

Unfortunately only a part of each square can be turned. Several inches out of every 48-inch square is stub waste. Then there is the cut-off waste between the turnings; and in the case of long turnings, a fraction of one is usually left over. If the square contains knots or other defects there is a further waste, as only clear stock can be turned. In the best practice it requires 1,400 board feet of squares to make 1,000 bound feet of clear stock which is actually turned; and in the poorest practice it requires 2,200 feet. For average purposes we consider that it requires 2,000 feet of squares for 1,000 feet actually turned. For 4,000 pounds of clear stock it is therefore necessary to ship from 5,600 to 8,800 pounds of squares, or if plank is used, from 8,120 to 12,760 pounds. On a 30-cent rate this means a freight bill of from $24 to $38 on every thousand feet of clear stock actually finished. In other words, fully half of every freight bill is to cover the transportation of waste. On the shipment of 1,000,000 feet with a rate of 30 cents the railroad receives at least $6,000 for carrying waste.

What these high rates mean when added to the prevailing prices of lumber are shown by the following: Where squares cost $50 per thousand, even under the best practice of manufacture, and with a freight rate of $12 per thousand the cost of 1,000 feet of clear stock at the lathe would be $86.80. If, on the other hand, the squares cost $60 f. o. b. car and it requires 2,000 feet to make 1,000 feet of clears the cost of the clear stock delivered at the lathe would be $144 per thousand with $12 freight rate; and $160 with a $20 freight rate. If plank were purchased at $50 f. o. b. car the cost of the clear stock would be about the same as from squares at $60. In these cases the freight amounts to 16 per cent and 25 per cent respectively of the cost of the material. The advantage enjoyed by a manufacturing plant near the timber supply is obvious. This is true in regard to other

wood-using industries as well as wood turnings, and is an important reason for the work of conservation and standardization recently undertaken by the National Association of Wood Using Industries, under the direction of Mr. Babbitt. Two or three measures naturally suggest themselves for eliminating part of this expense for freight.

Obviously only material to be actually manufactured should be shipped to a turning mill or other factory. This means that practically all sawing would be done near the woods; not only sawing out the squares, as is often done now, but the defects would be cut out of the squares. In other words we would ship bundles of odd lengths of clear stock instead of bundles of 4-foot mill run squares. With a 30 cent rate the freight on this clear stock would be $12 instead of from $24 to $38, as when the round edge plank is shipped. The only disadvantage in this method is that the waste wood would have little fuel value in a small place; while it has a value in the average city of about 8½ cents per bushel. The remedy for this difficulty would be the establishment at some junction point near the saw mills of a plant which would use the waste either for pulp or for distillation.

Two other remedies for the freight situation suggest themselves: Moving the finishing business nearer to the base of supplies, or moving a forest to the factory. There are difficulties in the way of both propositions. Many factories are so large and represent such a large investment that the owners would have difficulty in selling their plant for anywhere near what it is carried on their books. In many cases the plants are too large to be supplied by any forest which could now be purchased. They must, therefore, either be located at points convenient to several forests or the productivity of the forest must be increased to take care of the capacity of the plant. The competition for white birch which already exists in the Northeast between the turning and the tooth-pick industries on the one hand and the pulp and turning industries on the other makes white birch one of the most highly valued woods of New England and one which should receive much more attention from foresters than it has thus far received. How far the wood-using industries of southern New England can go in converting large areas of cheap lands into thrifty forests of valuable woods remains to be seen. One thing is certain, namely, that every manufacturing plant which relies upon virgin forests and makes no provision for a new growth should charge forest depreciation as well as plant depreciation into their overhead expenses.

There is undoubtedly enough waste land in southern New England to support all the wood-using plants of that region, if it were producing forest. The national program for reforestation should have the backing of every far-sighted manufacturer because of the saving which it will eventually mean in freight charges if for no other reason.

OPPORTUNITIES FOR AMERICAN FORESTERS IN THE TROPICS

By H. N. Whitford

There is an increasing demand for men trained in forestry for work of various classes in tropical countries. This outlet is a comparatively new one for American foresters and is likely to become larger as the years go by. It is due primarily to the fact that many tropical countries are beginning to be more fully economically developed. As a nation we are becoming more and more dependent on certain classes of raw material from other countries. This applies in general to kinds of raw material found both in temperate and tropical countries and to those materials that the tropics alone can produce. In this discussion we are especially interested in the raw materials of tropical forest products both those that are wild and those that have become so important that cultural methods have become necessary to keep the supply equal to the demand. To the former class lumber for general and special purposes belongs, to the latter class forest products like rubber belong.

Until recently many tropical countries, for economic reasons, have not felt the necessity of utilizing their own forest resources. In some cases their economic development has been so slow, the lumber they needed to keep pace with it was little, or was supplied mainly by imports from the highly developed lumber centers of North America. Before the war practically every tropical country in the world that had any industrial activity worthy of the name was importing lumber, many of them more than their own poorly developed lumber industry could supply. With the war the imported supply became practically shut off. Not only this but the importation of many classes of raw and manufactured products stopped. This stimulated local industries of all kinds to meet the new situation and awakened many tropical countries to the fact that they could do things they had never done before. It especially stimulated the local lumber industries to great activity and resulted in many countries doubling and even trebling the output of lumber from their own forests. Many kinds of tropical woods that were before thought to be worthless are now being utilized.

Some of these countries are seeking capital to make their lumbering industry more efficient, and capital in the United States and Europe is beginning to turn to the tropics for investment in lumbering on a larger scale.

Forest properties in tropical countries have too often been in the hands of unscrupulous speculators and promoters who do not intend to develop them but unload them on others. Capital has often been attracted to such investments on superficial and untrustworthy reports, whereas if it had been an investment in mineral resources, a mining engineer would have been called upon to make a report before the investment was made. The demand is now rising for trained men to make such investigations. For this work there is no better training than a good general course in forestry.

Some time ago the writer was asked to examine a tract of timber in the tropics in which a great deal of capital had been invested. The firm stated that it had had the opinion of an engineer and practical logging and milling men, but something was wrong—the proposition was not paying. It finally concluded it would be advisable to ask a forester to look the property over. While this company was logging all the timber, it was especially anxious to get as large an amount as possible of a certain class which brought a high price. Its estimates by practical cruisers showed that this class of timber was in the forest, but on examination by the writer of the lumber cut, it was not found in the yards. An examination of the forest showed that while the former cruisers were nearly correct as to the total amount of timber per acre there was very little of the special kind that might have made the operation a success. What probably happened was that the former cruisers confused two other tree species with the most valuable one, and put them all in as one. A well-rounded course in field dendrology such as is given in our forest schools would have enabled these "practical" cruisers to distinguish the minute differences between this most valuable species and the others, and thus the error could have been avoided.

In another case a forester was asked to check a cruise that was made in a tropical forest property. He found that the estimate of the amount of timber of a special kind on this tract was too high, because the area that the species occupied was over-estimated. Another mistake made was, attention was not called to the fact that a considerable part of the area in question was in an exceedingly rough country and under present conditions it would not pay to log the timber so situated.

While at present capital is laying emphasis on tropical experience coupled with a forester's training, it will have to come to accept the forester who has gained his experience in similar classes of work in our own country, because the supply of men with tropical experience is not equal to the demand.

Capital seeking investment in a tropical forest property often wants to know the agricultural value of the land after the timber is removed. A good forestry education fits a man to answer all the questions in a general way, including agricultural and engineering problems, better than any other one type of trained men. The trained agriculturist would likely know little about the forest or the engineering problems connected with its exploitation. The engineer would be at loss concerning the strictly forestry and agricultural problems. The point to be made here is that the forester is better trained to collect all the information essential to the success or failure of the proposition than either of the other type of trained men. In a word the forester is best trained to do this class of pioneer work. In this connection I can do no better than quote the last paragraph of an article written by Matthews,[1] Conservator of Forests for British North Borneo. This reads as follows:

"It is to the trained forester that we must look to do the bulk of the pioneering work which is necessary before any extensive development of the wild lands of the tropics can take place. This is not yet generally recognized but it will be and, as Sir William Schlich said to the writer in 1914, unless there is much more interest taken by the British in forest education, it is to America that the world will have to look for men to do this work since they are not being trained in sufficient numbers elsewhere."

A second class of work for the trained forester in the tropics is the seeking of the sources, kinds, and amounts of raw materials of the forests essential to certain industries. Some industries are getting exceedingly anxious concerning their future sources for raw products of various kinds. There are a number of instances where trained foresters have been employed in this service. Some time ago a forester investigated the coastal region of northern South America in search of tanning materials for a prominent leather company. Another forester has recently returned from an exploring expedition in the Quebracho forests of the Gran Chaco region of Paraguay and Northern Argen-

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[1] Matthews, D. M. The Trained Forester in the Tropics. Yale Forest School News, Vol. III, No. 3, July, 1920, p 36.

tina for the leather company in which he is employed. Still another forester is in the Malay region investigating the gutta-percha situation for an electric company. A trained forester is employed by a firm dealing mainly in imported tropical forest woods of various kinds. This man has made a number of trips to the tropics in matters connected with the business.

A third outlet for American foresters in the tropics has been created in the rapid advance made in recent years in rubber planting. Ten years ago rubber was largely a wild forest product. Today fully 90 per cent of the rubber of commerce comes from planted crops. Many of the problems connected with this cultural forest crop are those which the trained forester is best able to handle, and the rubber companies recognize this fact, for at least three American foresters are now employed by Dutch-American concerns in the Island of Sumatra. As other wild tropical forest products of especial kinds near the stage of exhaustion capital will become interested in raising them as forest crops, or will need men to discover new substitutes. The logical men to handle such work are foresters.

The fourth and last outlet for foresters is government employ in tropical countries. From this standpoint the tropical countries can be sharply divided into two classes. On the one hand there are the colonial possessions of European countries and the United States and on the other hand there are the independent States, some 20 Latin American republics.

Practically all countries with possessions in the tropics employ trained foresters. Some of these, like England, have a school where men are trained for tropical work especially for India. As a rule colonial tropical countries have drawn on the home governments for their foresters. There have been some notable exceptions to this. For instance the British North Borneo Government has two American foresters in its employ, together with a number of Filipinos trained in the Forest School of the Philippine Islands. One American forester is in charge of the investigative work connected with the forestry department of the Federated Malay States, and only recently a number of Americans have accepted positions with the British Government in India to carry on work connected with the exploitation and utilization of forest products. So long as the governments of European colonies in the tropics can find men to handle certain phases of forestry work from the home country they will not employ foreigners.

The outlet for American foresters in government employ in the Latin American republics is not promising for a similar reason. It is true that the Argentina government had two American foresters in its employ for a few years. Another reason is that these countries have not felt the need of trained foresters. This is because, except for a few notable exceptions, these countries are either in the stage of what Zon calls being "dominated by the forests" or the stage of "overcoming the forests." It is the writer's belief that not much progress can be made by foreigners in helping them to the stage of dominating the forests. This work must be carried on mainly by men of their own country, hence the campaign that the Yale School of Forestry has carried on to induce Latin American governments to train foresters. It is, however, probable that some of these countries will be calling on American foresters to act in an advisory capacity or to handle special investigative problems.

The chief outlet for American trained foresters has been in the tropical possessions of the United States, especially in the Philippines, and to a less extent in the Hawaiian Islands and Porto Rico.

More than thirty foresters trained in the forest schools of the United States have been employed by the Philippine government at different times in the last twenty years. Five of these are still connected with that government and seven have migrated to neighboring countries to accept more responsible positions in private work or are connected with the forestry departments of neighboring governments. One is engaged in private work in Brazil. Thus the Forest Service of the Philippine government has been the principal training ground for American foresters to get their experience in tropical forestry. Nearly half of them are still engaged in tropical work connected with forestry. The training ground in the Philippines for experience in tropical conditions is still open to a limited number, but since the policy of the Philippine government has been to train Filipinos for such work as can be done by them, the demand for Americans has not been so great.

As has already been stated employers wishing men for tropical work related to forestry almost always seek those with tropical experience if they can be found. For this reason they often take men who have had experience in the tropics without regard to special training in forestry. This is natural, for the white man instinctively has a fear of the tropics. The employer does not want men who are not known

to be able to adjust themselves to the new environment. While the fear of the tropics is more or less inbred in inhabitants of temperate regions, it is largely psycological rather than actual, brought on by exaggerated statements concerning climatic, hygienic, and moral conditions of the tropics. These conditions are bad enough without making them worse than they actually are. They are sufficiently different from ours to make it impossible for a certain class of men to make a success of their work, whereas they would be counted as successful men in similar positions in temperate regions. Fischer,[2] the Director of Forestry in the Philippine Islands, in a recent article calls attention to the type of man that makes a success in the tropics. I can do no better than quote certain passages from this article:

"As stated above, success depends on the man and this is particularly true in the tropics. Many men who make a success in the temperate zone are failures in the tropics. Climate, health, worries, homesickness, disgust at surrounding conditions and other factors tend toward discouragement, but love and enthusiasm for tropical work can overcome many of these factors. Most white men with ordinary precautions can live in the tropics. The precautions are few, but must be observed rigorously—care in drinking water, protection against mosquitoes, and avoidance of physical excesses of all kinds.

"Two things that mitigate both the discomforts and dangers of the tropics are, first, that generally the nights are always cool and, second, medicinal knowledge has advanced greatly and the dreaded intestinal diseases, such as amoebic and bacillary dysentery, are easily cured if treatment is begun in time.

"That heat is at first enervating, and discourages many, there is no doubt. The essence of the matter, however, lies in most cases in the word 'discourage.' A man who does not let the heat and sweat discourage him in the first weeks or months, soon gets used to it and takes it all as a part of the day's work. There are hundreds of white men whose mentality is as keen and moral stamina as staunch as ever, despite years of residence in the tropics, but these are, as a rule, men who have not permitted the climate to run them down physically. *Mens sana in corpore sano* is as true here as in any other part of the world. . . .

"One's attitude toward things in general and the work with natives of the tropics may mean success or failure. An impersonal attitude or a cold exterior, particularly in the tropics, gives the impression of lack of sympathy and retards the work. Being '*muy simpatico*' with the people, their habits, manners and customs, with firmness and a

[2] Fischer, A. F. The Fundamentals of Success in the Tropics. Yale Forest School News, Vol. III, No. 3, July, 1920. pp. 35-36.

sense of justice are assets to any white man in the tropics. To really understand the thoughts and mental processes of any people, it is a necessity to know the language of that people, and Americans are not noted as linguists. Particularly foresters, who are constantly coming in contact with the common people in outlying districts, should have at least a working knowledge of the language, as much valuable and useful information can be obtained and the work made easier along all lines. . . .

"If I have not touched on any detailed problems, this is because I wished to emphasize, as said above, that the success of the work depends not so much on methods as on men—the character of the players is more important than the rules of the game.

"Finally, I would repeat that forestry work in the tropics is intensely interesting; the very difficulties encountered in seeking out the unsolved mysteries of the tropical forests create an interest that verily absorbs the man engaged in the work and makes him either forget the physical discomforts and social or political obstacles he meets, or else strive all the harder to overcome them."

After all that is said the essentials for success in the tropics are the same as those for temperate regions. The main difference is that the weeding out is a little higher up the scale. Men with weak, or mediocre moral characters, without much initiative, and especially those weak physically, are not likely to succeed in the tropics, whereas in temperate regions they may attain some degree of success because of better living conditions and moral environment.

Nearly all those who have made a success in the tropics had no special training other than a general all-round course in forestry. Perhaps none of them contemplated going to the tropics when they received this training. The opportunity came and they accepted it. In many cases the first year was spent in adjusting themselves to the new conditions and to getting over being afraid of the tropics. Some men do this more quickly than others. Especially is this true of those who have had experience in the wilder parts of our own country, where with the exception of the climate the general social conditions are not entirely dissimilar.

Training in school cannot wholly take the place of experience. The general course that is given in tropical forestry at Yale has for its main object to supplement the work of the other courses associated with it. It strives to give in a general way the essential differences between temperate and tropical forests, and to point out how the economic

problems connected with their destruction and exploitation differ from our own, and the degree to which forestry can be practiced.

One of the great difficulties of studying a tropical forest for the first time is its great complexity. For this reason better acquaintance with systematic botany than is obtained in most forestry schools is very helpful. One does not need to be a systematic botanist, but he does need a keen and thorough course in learning to distinguish one tree from another. A good course in systematic botany coupled with one in field dendrology ought to give such training. Armed with this and with some knowledge of collecting and drying botanical specimens and collecting wood specimens, he can with the aid of systematic botanists and wood technologists gain the essentials concerning the composition of the forest. It is surprising how quickly a working knowledge of the composition of a given tropical forest can be obtained by patient and persistent effort. I have had foresters working with me who claimed that it was an impossible task, yet with one, or at the most, two weeks, they have become sufficiently acquainted with the trees so that they could work independently. With this knowledge their attitude toward the work changed from one of listlessly depending on the native woodmen for the name, to one of keen delight in discovering that they had obtained information that would enable them to check the native helpers. Before this they literally could not "see the forest because of the trees" and became discouraged.

Coupled with the difficulty of knowing the trees is the one of recognizing the many woods found on the market. A good course in the identification of American woods gives one a fairly good background for extending this work to tropical woods. Special courses are offered at Yale on tropical woods that are designed to make one more efficient in this line of work. Special courses in other phases of tropical forestry are given to meet the needs of the student who contemplates practicing his profession in a particular section of the tropics. It is believed that the instruction given in the various lines of tropical forestry, while they do not entirely take the place of actual experience, yet they will help one to adjust himself more easily and quickly if he contemplates doing work in his chosen profession in tropical countries.

With regard to the general courses in forest management, in silviculture, and in lumbering, it can be stated that the better foundations one has in these subjects the better he is equipped to apply this knowledge to tropical countries.

Of course, adjustment of this knowledge is necessary to meet the different economic conditions and the differences in the character of the forests that are dealt with. In as far as possible, the general course in tropical forestry deals with these problems of adjustment.

It is not too much to assume that a general course in tropical forestry has some direct and indirect value to the student who does not contemplate practicing his profession in tropical countries. Problems connected with future progress in better conservation of our forests are intimately connected with the source of raw materials from the forests the world over. In the general courses he obtains information concerning the forests and forest conditions of European countries but little about those of tropical countries. With more knowledge of the nature and value of tropical forests he can better appreciate the nature and value of our own forests. Many tropical forest products are absolutely essential to our present economic life and are becoming more and more so. Certain industries are wholly or partially dependent on such products. Each year finds old industries turning to the tropics for new sources of raw materials, and new industries depending on tropical forest products are being established. Exaggerated ideas concerning the nature of the tropics and their forests are afloat. A sane view concerning the present importance of tropical forests and the rôle that they are likely to play in the future is becoming essential to a well-rounded course in forestry. It is believed that the course that is given in tropical forestry has indirect cultural value, for a knowledge of the relations that people of tropical countries have to their forests, how they exploit and use them and look upon them, gives an insight into the character of the people themselves, and the more knowledge one has of our tropical neighbors and their problems the better educated he is.

CONCERNING THE DURABILITY OF THE WOOD OF THE MAIDENHAIR TREE, GINKGO BILOBA

By Henry Schmitz,

School of Forestry, University of Idaho

It is a matter of common observation among horticulturists and gardeners that the maidenhair tree is unusually free from heartwood decay.

Although being an oriental species, Ginkgo biloba is now extensively planted throughout the warmer regions of the middle west and east as an ornamental tree. In these regions, the tree makes very good growth, often increasing in diameter at the rate of one-half inch per year. In the Northwest and Pacific Northwest, the tree makes practically no growth. This may be due to the absence of warm nights during the growing season.

The fact that the tree makes very good growth in certain sections of this country and its desirable form for the production of fence posts together with the probable durability of the wood suggested to the writer that the maidenhair tree might be suitable for planting in farm woodlots provided that the wood is as durable as generally thought.

In order to test the durability of this wood, it was subjected to the action of six common wood-destroying fungi. The method used was briefly as follows: Small blocks, approximately 1 by 1 by 2 inches were sawed from a piece of sound heartwood. These blocks were dried to constant weight in an oven at 100 degrees C. and carefully weighed. Six blocks were then placed in each of seven 1-quart Mason jars having a layer of absorbent cotton on the bottom. The cotton and blocks were moistened with distilled water, the jars plugged, and sterilized at 15 pounds pressure for 20 minutes. After sterilization, one flask was inoculated with each of the following fungi: *Lenzites saepiaria* Fr., *Polystictus versicolor* (L.) Fr., *Fomes pinicola* Fr., *Trametes pini* Fr., *Fomes roseus* Fr., and *Polyporus lucidus* (Lys.) Fr.

After four months' incubation at room temperature, the blocks were removed from the flasks, the fungous mats carefully removed from the blocks, the blocks again dried to constant weight at 100 degrees C. and

weighed. The amount of decay is indicated by the loss in weight. Table 1 shows the average loss in weight of six blocks when subjected to the action of the various fungi indicated:

TABLE 1.—*Loss in weight of Ginkgo wood caused by the action of wood-destroying fungi.*

Fungus	Loss in weight, per cent[1]	Remarks
Lenzites saepiaria.......	7.8	Well decayed areas throughout blocks
Polystictus versicolor...	3.0	Blocks entirely covered with fungous mats
Fomes pinicola.........	4.5	Well decayed areas throughout blocks
Trametes pini..........	3.6	Blocks entirely covered with fungous mats
Fomes roseus...........	3.6	Blocks entirely covered with fungous mats
Polyporus lucidus.......	3.3	Blocks entirely covered with fungous mats
Control	...	No change

[1] Average of six blocks.

These results clearly indicate that the wood of Ginkgo biloba is not unusually resistant to the action of the common wood-destroying fungi under the conditions obtaining in this experiment and that the absence of unsound wood in the living tree will probably have to be explained on some other basis than inherent resistance in the wood itself.

SECOND NATIONAL CONFERENCE ON EDUCATION IN FORESTRY

By J. W. Toumey

The first national conference on education in forestry in the United States was held in Washington, D. C., December 30, 1909. This conference was called through the initiative af Gifford Pinchot. Its object was fully set forth by H. S. Graves, in an article in the March, 1910, number of the Forestry Quarterly. At that time there were over twenty institutions in this country and Canada which gave instruction in forestry, and forestry was just beginning to attain a recognized place in educational circles in this country. There was no recognized standard of professional training as shown in the wide difference in scope in the forest schools and the great diversity in attainments of those calling themselves professional foresters. As pointed out by Graves the Civil Service examinations served in a measure as a professional standard, but as only a part of the men trained in the schools took the examinations they scarcely answered the purpose.

The real purpose of the conference was to take the first steps in an agreement among the schools as to the character and minimum technical training required of a forester of the different grades. It was emphasized that the pressure to emphasize the practical application of forestry without due attention to the theory endangered the best development of forestry education. It was also recognized that the omission or restriction in time of study given to the essential preforestry subjects in science and language was disastrous to the best training of the forester. At that time practically all the forest schools had developed within the previous decade and it was emphasized that they must provide a better training than in the past when they were in the period of organization and the adjustment of their curricula, and when instructors of adequate background and experience were not available.

Looking back over a period of ten years it is clear that the Washington conference attended by delegates from nearly all the forest schools then in existence in America had far reaching effects on forestry education in this country during the past decade.

One of the important results of this conference was the appointment of a committee on forestry education in America with H. S. Graves as chairman. The purpose of this committee was to prepare and report upon a plan looking forward to a better standardization of forestry education in the different grades in this country. The committee reported in Washington, in December, 1911, at a meeting attended by representatives from sixteen forest schools and departments of forestry in American colleges and universities. The plan proposed by the committee was discussed in detail and action taken on matters relating to admittance to schools of different grades, curricula and the number of hours in each subject. The final report embodying action taken at the meeting was published in the Forestry Quarterly for September, 1912.

The majority of the committee and the representatives of the institutions present at the meeting recognized that there should be in America four different grades of instruction in forestry.

(*a*) Advanced professional training, to include not only a substantial general education but also a well-rounded course in all branches of technical forestry.

(*b*) Instruction for forest rangers, based upon a high-school education or its equivalent, and conducted mainly along thoroughly practical lines.

(*c*) General instruction in forestry supplementary to a course in agriculture and designed to be of assistance to owners in the handling of woodlands.

(*d*) General course in conservation and forestry for those who desire it as a part of their general education.

Although the above grades were recognized the work of the committee in the final report was confined to formulating standards and requirements for professional training leading to a degree. No action was taken on secondary forestry education; however in 1913 a subcommittee on secondary forestry education, of which the writer was chairman, was appointed by the National Conservation Congress to present a report at the November meeting of that year. This report published in the Proceedings of the Fifth National Conservation Congress discusses the development of secondary forestry education in the United States and outlines curricula for various grades of schools and colleges that offer courses in forestry subjects below the grade of full technical training.

Since 1913 there has been no conferences on forestry education and no extended journal articles dealing with this important subject. Each school has been left to work out, extend, and re-shape its curriculum without reference to other schools, at least without mutual discussion and helpfulness. As a consequence forestry training in this country in the various grades has tended to diverge more or less from the standards discussed ten years ago. To considerable extent local needs have emphasized extended training in certain subjects to the elimination or almost total suppression of others essential in a well-rounded course. In not a few instances the stress for time has restricted the attention that should be given to pre-forestry subjects and foresters continue to leave our schools with insufficient background in general educational subjects.

For some time the writer has recognized the need for a second national conference on forestry education, and in the early summer of 1920 he was urged by many foresters engaged in educational work to call such a conference to convene at New Haven, Conn., December 17 and 18, 1920. In order to facilitate the work of the congress and make it productive of the most good the following list of subjects for investigation and report upon were assigned to committees some months prior to the meeting:

(*a*) The undergraduate forestry course leading to the degree of Bachelor of Science or Bachelor of Science in Forestry. Chairman, R. S. Hosmer.

(*b*) The course leading to the degree of Master of Forestry. Chairman, H. H. Chapman.

(*c*) Specialization in the courses leading to the degrees of Bachelor of Science in Forestry and Master of Forestry. Chairman, F. F. Moon.

(*d*) The scope and character of training for specialists in forest products. Chairman, S. T. Dana.

(*e*) The scope and field of vocational training in forestry. Chairman, Hugo Winkenwerder.[1]

(*f*) Forestry subjects as cultural and educational discipline in public and private schools, colleges and universities. Chairman, Dr. C. D. Jarvis.

(*g*) Should "Public Relations" receive a place in the training of foresters. Discussion by Herbert A. Smith.

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[1] Report of committee prepared by J. B. Berry and presented at the conference by E. A. Zeigler.

(*h*) Extension work in forestry as a part of extension courses in colleges and universities. Chairman, K. W. Woodward.

(*i*) The character and extent of research in forestry by schools of forestry and departments of forestry in colleges and universities. Chairman, R. T. Fisher.

The feature of this conference was the thoroughness with which the reports were prepared and the constructive value that they offer to those responsible for shaping forestry education in this country in the immediate future. The reports are far too long and comprehensive to be even outlined in this article. On the whole they show the trend of American forestry education at the present time and they indicate with much greater clarity than heretofore the deficiencies which must be overcome in the future.

Most of the Eastern and Middle Western schools, the U. S. Forest Service, and many State departments of forestry were represented at the conference. There were also present employers of foresters and others interested in forestry education. The attendance for part or for all of the two days' session was between fifty and sixty. As foresters from the Rocky Mountain and Pacific Coast regions were members of some of the committees it can be said with fairness that the conference was national in scope.

The presence of Dr. Claxton, U. S. Commissioner of Education, who participated in the conference, served in a real sense to link the comparatively new field of forestry education to the educational institutions of the country as a whole. His generous offer to publish the Proceedings of the Conference through the U. S. Bureau of Education will give the results accomplished by the conference wide distribution and help forestry education in attaining the position that it merits in our educational system.

J. W. Toumey was elected chairman of the conference and T. S. Woolsey secretary. A committee on resolutions, a committee on recommendations as to permanent organization, and an editorial and publications committee were appointed early in the conference, each of these committees to report the following day.

REPORT OF THE COMMITTEE ON PERMANENT ORGANIZATION

The committee recommends:

That the Society of American Foresters provide for the appointment of a permanent committee dealing with all matters relating to

forestry education; that the committee consist of seven members, three representing schools of forestry, one the U. S. Forest Service, one a State forest service, one the wood pulp industry and one the lumber using industries. It is not recommended that this conference as such be made into a permanent organization.

R. C. BRYANT, *Chairman.*

By recommendation of R. C. Bryant, chairman of the committee on permanent organization, the vote on the report of this committee was deferred until after the report of the committee on resolutions.

REPORT OF THE COMMITTEE ON RESOLUTIONS

Whereas, it is felt that the constructive work that this conference has done in furthering forestry education in this country should be continued and the deliberations of the conference made available to the public be it resolved:

That this conference accept with appreciation the offer of Dr. P. P. Claxton, United States Commissioner of Education, to publish the proceedings of this conference.

That the conference recommends to the Society of American Foresters:

First. That it appoint, through its President, a committee on forestry education, to consider all suggestions made to this conference, whether in formal reports or otherwise, together with such other phases of forestry education as it deems advisable.

Second. That this committee consist of (*a*) the chairman of this conference as chairman, (*b*) the chairmen of the eight committees reporting to this conference in those cases where they are senior members of the Society and in cases where they are not of some other member of the committee who is a senior member of the Society, and (*c*) of those other members.

Third. That this committee be authorized to appoint sub-committees which may include persons to be appointed by the chairman who are not and do not by virtue of such appointment become members of the main committee; and

Fourth. That it report the results of its investigations with recommendations to the Society from time to time.

H. H. CHAPMAN, *Chairman.*

As the recommendations of the committee on permanent organizations were provided for in the report of the committee on resolutions, action was not called for on the report of the former committee. The report of the resolutions committee was unanimously adopted and provision was made for transmitting a copy of the same to Dr. Claxton and to the Secretary of the Society of American Foresters.

A motion was made and accepted that the committees reporting at the congress be continued until the proceedings of the conference are made ready for publication by the committee on editing and publication.

Not only did the conference strike a high note in educational matters in forestry, but provision was made for the publication of the proceedings and for a permanent body through which all matters relating to forestry education can be referred for analysis and presentation to the entire body of American Foresters.

In conclusion it should be said that at the annual meeting of the Society of American Foresters in late December provision was made for the committee on forestry education as recommended at the conference and the committee appointed.

REPORT OF NATIONAL RESEARCH COUNCIL FOR SOCIETY OF AMERICAN FORESTERS

The following report deals with the activities of the Division of Biology and Agriculture of the National Research Council aside from the Forestry Committee, which is being reported upon by Mr. Zon. This division has been very active and is working on a considerable number of projects for stimulating research in various lines, but only such projects as deal more or less directly with forestry will be considered in this report.

The Research Council is based upon the scientific societies of the country, and its accomplishment will depend upon the support and interest of these societies. Since the council is trying to help the societies, it is in the interest of the societies to assist the efforts of the council. Research is being stimulated in a number of ways. Perhaps one of the most important is in bringing together scientists working in different fields, thereby creating among investigators a better understanding of each others problems and securing effective cooperation. Many sciences have reached the point where, although the field has not yet been fully covered, contact and cooperation with related sciences are essential to full development. This applies to forestry perhaps more than to almost any other science, since many of our problems are dependent for their solution upon research in various fields. Suppose, for example, we have to reforest 1,000 acres of burned over mountains. We first use the data we already possess bearing on the problem. But this is not enough—we must turn to meteorology for accurate data on climate; we must call upon the student of soils to help determine the character of the soil and its suitability for different tree species; we turn to the zoologist to protect our sowings from rodents; we ask the assistance of the entomologist in preventing insect attacks, and of the plant pathologist in overcoming diseases, and so on. Our practice is thus based on a large number of sciences, all of which are of importance in determining the requirements of the forest and in successfully handling it. At present many men are carrying on work in various lines without realizing the bearing of their work on each others problems; they are leaving gaps which need to be filled. The Research Council is helping to fill these gaps and to bring together workers in

allied lines for solving problems of the utmost importance which would otherwise remain untouched.

The division works by committees, which are formed to investigate and report upon points. These committees may or may not become standing committees, depending upon the nature of the problem. Some projects are referred to the Executive Committee of the division for consideration.

One of the committees which should be of assistance in bringing together research workers in related fields is the Committee on Current Problems. The purpose of this committee is to consider ways and means of securing and publishing current problems in biology, in order that investigators may have a view of the field as a whole and see gaps in the different subjects; this will give an opportunity of calling attention to problems in a field in which the investigator could not follow it and thereby enable others better equipped, or who would not have known of the problem, to take it up. This committee does not itself propose the problems, but receives those sent in by others. Unquestionably foresters will benefit by sending in to this committee well considered outlines of problems bearing upon their work. The chairman of this committee is Dr. G. N. Collins, of the Bureau of Plant Industry, Washington, D. C.

Foresters are directly concerned with the Institute for Tropical American Research being formed by the Research Council. The aims of this institute are to bring about cooperation between institutions and organizations interested in tropical American research. One of the most important lines needing attention is the forests. Forestry has been represented in the development of the project and is now well recognized by having Professor Toumey as one of the seven members of the new institute, which will bring about better co-operation and facilitate the work in tropical America.

Among the other activities of the division, which can be mentioned without being dwelt upon, are projects for study of food and nutrition, for animals as well as for man; a proposed organization of plant pathologists and industrial corporations for the study and control of plant diseases in order to diminish losses to crops in the field and to produce on the way to the consumer; and the Publication Committee, which is endeavoring to improve publication facilities and bibliographical work throughout the whole field of science.

The aim of the council is to help and stimulate research, not to control it, and its entire organization and spirit are thoroughly democratic.

December 20, 1920. BARRINGTON MOORE.

REPORT OF THE FORESTRY COMMITTEE, DIVISION OF BIOLOGY AND AGRICULTURE, NATIONAL RESEARCH COUNCIL

The Forestry Committee was organized in the spring of 1919. The organization of a Forestry Committee in the National Research Council, which is a part of the National Academy of Science, may be considered as a recognition of forestry as a scientific profession by the older scientific institutes. A forests committee was organized not because the existing forest organizations, the Research Branch of the Forest Service, forest schools, and the State forest research departments, have not been fulfilling their tasks. The National Research Council may be looked upon as a "congress of scientists," democratically elected or, to use a military simile, a scientific general staff which, when emergency arises, is supposed to mobilize all the scientific forces of the country upon its solution. Its function as it has been conceived is first to have representatives of the forest profession in that congress of scientists and have a voice in the management of the scientific affairs of the country. On the other hand, it is to keep in close contact with its constituency—the forest profession—and to be alert to any needs that for one reason or another are inadequately met by the existing organization.

In the survey of the field of forest research it found that there is a great field in the southern pine region, and particularly in the possibilities of our cut-over forest lands. Scattered efforts were made by the Forest Service and by the State Foresters to solve some of the problems, but no attempt was made to solve the southern problem as a whole—the Forest Service because of lack of funds and the State Foresters, of course, because they could not work outside the boundaries of their State. It was felt that such an undertaking must be on a cooperative basis; the Forest Service first of all, the State forest organizations, the forest industries, and the National Research Council. The Forestry Committee was fortunate in securing the cooperation of the Southern Pine Association, which contributed $10,000 for three years, as well as the cooperation of most of the State Foresters of the South, and of the Forest Service. There is now available for this year between $5,000 and $6,000 for this work. One of the first things

which, in the opinion of the committee, was essential for determining the forest possibilities of the cut-over land in the South, was the collection of data for and the construction of yield tables. This raised the whole question which has been discussed for so many years among foresters as to whether we ought to have empirical yield tables or what in forest mensuration are called "normal" yield tables. After long discussions the committee finally decided that yield tables based on sample plots picked at random, plots of different stocking, burned over, and ravaged by hogs, would not give any definite standard by which to measure the possibilities of the cut-over land. On the other hand purely normal yield tables would be too far ahead of the needs of the time.

As the matter stands now, the selection of sample plots will be confined to present stands but well-stocked and which have escaped fires and do not suffer from the grazing of hogs. These are the yields which may be reasonably expected in the South with some form of protection against fire and hogs—a goal which it is hoped will be consummated within the near future. This is the first attempt in this country, as far as I know, to secure yield tables for a large region. The sample plots so far measured by the Forest Services, States, and forest schools, will be utilized as far as they can fit in in the general scheme. There are available in all 103 sample plots for longleaf pine, 524 for loblolly, and 140 for shortleaf. A special form for recording the field measurements and instructions for the selection of the plots were prepared by the committee and generally approved. Three site classes, based on height, have been adopted. Soil samples from each plot will be secured and analyzed and a correlation made between the site and the soil condition.

A computer will be secured and probably attached to the computing force of the Forest Service, but will give her entire time to working up the field data from the southern pine region.

The work is now fairly well under way and I hope by this time that two men are in the field in Texas taking measurements on sample plots.

Parallel with this field work for collecting data for normal yield tables observations will be carried on and all the available knowledge collated as to the silvicultural treatment of the southern pine forests. By the end of the next calendar year the committee hopes to have a preliminary report ready.

If the work proves successful the plan is to extend a similar preparation of yield tables to other regions through cooperative efforts.

Besides carrying on this field project, the Forestry Committee has now four permanent sub-committees: (1) On forest products, (2) on silviculture, (3) on forest economics, and (4) on forest management.

The purpose of these sub-committees is to keep in touch with the different lines of research work in forestry, assist in the promoting of research projects most needed, and stimulate research in general. At present it is not the purpose of the sub-committees to undertake any scientific projects of its own but rather see that the existing agencies are carrying on the needed work and assist in securing the necessary funds or facilities for the work.

The Forestry Committee aims also to serve as a clearing house for all the forest scientific activities, including forest education. One of its first tasks is to find funds for the establishment of forest fellowships in several of our forest schools; to see that in any big lines of related work that may be undertaken by the National Research Council and may have a bearing upon forestry the foresters' viewpoint should be made to bear upon the problem. As an instance may be mentioned the recently organized Crop Protection Institute. This institute is made up of plant pathologists and the industries engaged in the manufacture of fungicides and insecticides. At the time the institute was organized the forest crops, for one reason or another, had been overlooked. The Forestry Committee promptly brought to the attention of the institute that protection of forest products from insects and diseases and the preservative treatment of wood are legitimate functions of such a crop institute. I hope the field of the institute will be enlarged to include such a large crop as the forests are.

In concluding I wish to emphasize that the Forestry Committee is nothing but a representative of the forestry profession and particularly of the Society of American Foresters in the congress of scientists, known as the National Research Council. If your representative—the Forestry Committee—does not carry out or does not serve the best interests of the profession it is your fault if you do not insist that it should be thoroughly representative of the needs of the profession in the field of forest research, and if the present personnel does not carry out your wishes it should be supplanted by others who will. I would suggest, therefore, that you keep an eye on your Forestry Committee, help it with your advice and moral backing when it deserves it and criticize it unmercifully if it deserves it.

RAPHAEL ZON,
Chairman, Committee on Forestry.

December 17, 1920.

REVIEWS

Loblolly Pine. By W. W. Ashe. North Carolina Geological and Economic Survey, Bulletin 24.

After having turned to it two or three times for needed help, with the result each time of being thoroughly satisfied, one is led to wonder why a work that has been out six years and covers a very important field has never been reviewed in the periodicals of the profession.

Treating loblolly pine, the most important timber tree of the State, the work is stated to have been "designed to meet the needs af all our people who are in any way interested in timber." Save in one respect, to be referred to later, it appears adequate to this purpose, not only at present but in future. Explaining that in part is the background of lifelong familiarity with the territory concerned on the part of the author. Next one observes regard paid to actual facts and conditions with appreciation of economic forces. Lastly, to round it out, is a sure grasp on the ideal and a clear look into the future. Whether or not North Carolinians and their neighbors are turning to this work for guidance in these days is not known. (They are losing much if they do not.) Men of the future, driven by greater pressure, will certainly do so, and will find there answers to their problems.

Looking over the work for high spots to touch, the chief difficulty arises from wealth of material. Perhaps as notable a feature as any is the clear and thorough way in which the relations between soil and silvical phenomena have been covered. This is a point at which weakness has been frequently displayed by the profession; in the South it is all important.

The relation of age and site quality to lumber produced is another matter fully dealt with, one of vast importance to the man who is actually growing timber. In this connection one can not but think of the volume of detail work that lies behind the summary statements.

Foresters at large will be more readily attracted by some other things. Management is here fully discussed, with a fullness and detail in fact that could be grasped only by one familiar with the territory. The light thrown on recovery from suppression illustrates this particularly. Other points of importance and difficulty covered in a similarly

convincing way are the unusual early growth of pine on old fields and the effect in different conditions of fire.

It was intimated earlier that in one respect this work might perhaps not adequately meet the requirements of those at whose needs it is directed. Reference was made to the presentation. A day or two of clear time for reading and digestion, it might seem, should not be begrudged a thorough-going book by those whose interest or interests it touches, yet few probably, whether business men or of the profession, make up their minds to it. Though in logical order and not over-technical, the work is not easy reading, while the great number of tables contained make it really formidable looking. In every one of these to be sure there is meat and meaning, but present results from the bulletin might perhaps have been greater if it had been put up in two sections, text and an appendix.

However that may be, the work is a monumental one. Seeing that it is now six years since it came out and that his labors meanwhile have been applied in other fields, it is probably true that Mr. Ashe has forgotten more about loblolly pine in and bordering North Carolina than any but a very few living men will soon know about it.

AUSTIN CARY.

The Adventitious Nature of the So-Called Medullary Rays. By Herbert Stone. Cambridge, England, September 10, 1920. Printed by Butler and Tanner, Frome and London. Pp. 14, pls. 6, list of 20 references, none later than 1914.

The author expresses the opinion that the rays are "stop-gap-tissue." He concludes that "whenever a gap, however caused, occurs in the wood in the neighborhood of living cells, the space is filled by new tissue produced by those cells." (Trecul's idea, 1852, with reference to the potentiality of young living cells, not cambium.) "This new tissue is called, according to circumstances, rays, callus, flecks, or tyloses. The ray is the tissue occupying a slit rent in the cambium by the increase in the periphery of the stem, chiefly at the period when the cambium is dormant. The slit is a wound that is kept continually open by the same increase in the periphery. As the cambium has double duty to perform at those points it lags . . . and notches or indentations on the transverse section are produced in the contour of the rings. The form of the ray and the prostrate position of its cells are due to the occupation of a horizontal slit. The ray tissue in its

inception is observed to be always in a state of confusion and the cells to be distorted as are also the adjacent wood fibers, a phenomenon never observed in connection with normally produced tissue."

The author's hypothesis, as summarized above, is discussed by him in the light of the views expressed in the older text books by T. Hartig, Sachs, and later by Strasburger and others, with special reference to the relation of interfascicular cambium and rays. He considers the radial division of the cambium and cambial activity in ray formation inadequate to account for the circumferential expansion of the tree. The author also uses his hypothesis to explain the presence of multiseriate rays associated with leaf traces, the increasing number of rays as the stem increases in age, the formation of pith flecks (which he considers healing structures of the same type as rays), ray conditions in all cases of wounds, bird's eye in maple, the differences between "exogenous" and "endogenous" woods, intercellular spaces in rays, and further concludes that rays are valueless for classification or phylogenetic purposes, although possibly useful as a generic or subgeneric character in oaks. He advocates that the term "medullary rays" be strictly confined to the partitions of the pith in the early portion of the first year, before the cambium has commenced to produce wood. The observations of Erich Schmidt on the "proximal end-cells" of the rays are discussed in support of the author's views.

With reference to the function of the rays it is stated that "the rays as channels for the conveyance of sap in a horizontal direction are as much inferior to an open unoccupied slit as an intercellular canal, as is a vessel obstructed by tyloses." That they may aid in rupturing the bark in spring is also postulated. The radial shearing which has been seen to take place when a dry disk of wood is placed in water is cited in support of this.

The chief difficulty with the views cited appears to be that, as the author himself states, he has not seen nor has he found references to investigators who have seen the ray mother cells at the cambium. Consequently on theoretical grounds he contends that the cambium (he appears to consider all cambial cells alike) cannot produce daughter cells "that are not in their own likeness." The recent work of I. W. Bailey, especially that published in the Journal of General Physiology, Vol. 2, page 519, May 20, 1920, and also in the American Journal of Botany and elsewhere, on the nature and activities of the cambium, is very illuminating in this connection. E. G.

PERIODICAL LITERATURE

SILVICULTURE, PROTECTION, AND EXTENSION

Different Tree Species in Sweden

Statistics in regard to relative light requirements and rate of height growth for different tree species in Sweden show that the culmination of height growth occurs earlier in the "light-demanding" than in the "shade-enduring" species. The most "light-demanding" species such as larch, birch, and pine, attain their maximum rate of height growth at 10-15 years, while in the most "shade-enduring" species, such as spruce and beech, the maximum is reached at 30-40 years. This relation does not always hold in comparing trees growing on different sites and under different climatic conditions. Such discrepancies, however, are apparent rather than real, due to the fact that under unfavorable growing conditions the age of a tree as expressed in calendar years is not a true index of its progress in the life cycle of the species. Height growth culminates later, as measured in years, in a tree growing under unfavorable conditions, than in a tree of the same species growing under favorable conditions. It is also commonly accepted that trees growing under unfavorable conditions have higher light requirements than trees of the same species growing under favorable conditions of soil and climate. The author concludes that if proper standards of comparison are utilized the relative light requirements and the culmination of height growth remain the same for a given species under varying conditions of site and climate. G. A. PEARSON.

Amilon, J. A. *Höjdtillväxtens förlopp hos träd med olika liusbehov.* Skogsvårdsföreningens Tidskr., 17:95-108. 1919.

The Pine Heaths of Norrland

In portions of Norrland, Sweden, the pine forests (*Pinus sylvestris*) reproduce themselves with such difficulty as to cause serious concern among foresters. The ground is usually covered with a dense mat of lichens, mainly *Cladina alpestris*, which grow to a height of more than a decimeter. The lichen mat apparently does not seriously interfere with germination because young seedlings are

abundant. They do not, however, develop normally and soon die. Earlier investigations which Hesselman has carried on for more than 10 years have shown that death is not due to drought, lack of light, grazing, snow pressure, or competition with brush and lichens. Numerous chemical analyses have shown that wherever the pine seedlings develop normally the soil contains a noticeably higher per cent of available nitrates than where they are of poor development. The conclusion, therefore, is that available nitrogen in the soil is the critical factor. The presence of decaying wood or leaves when mixed with the mineral soil seems to promote nitrification. Seedlings grow much better near older trees, stumps, and decaying logs than in the open. Experiments of 10 years' standing have shown a marked improvement as a result of mixing sod with the soil, or even merely stirring up the soil with a hoe. Similar results are often observed after logging operations in which the surface layer of organic matter is mixed with the soil, thus promoting nitrification. G. A. PEARSON.

Hesselman, Henrik. *Studier över de norrländska tallhedarnas föryngringsvillkor.* Skogsvårdsföreningens Tidskr., 17:29-76. Figs. 1-16. 1919.

Afforesting the Barren Heaths of Denmark

Most foresters know of the success reached in afforesting the barren heaths of Jutland, Denmark, but few have realized the years of experimentation and the unflinching faith and courage of those who fathered this project. Though several companies, which had been promoted for reforesting the dunes, had failed, Enrico Dalgas became convinced that it could be done and gave himself and his fortune to the work. The company which he organized has successfully reforested 80,000 hectares and the Danish Government 50,000 hectares. The work began about fifty years ago, and at the present time only 40 per cent of the total waste area remains unreclaimed. The 55-year-old stand of Norway spruce, planted where nothing but worthless brush grew, yielded 3,950 cubic feet per hectare. The work is done as follows: The heath is burned, then plowed and disked and allowed to remain thus three years, plowed again a little deeper and in a manner to break up all roots and again left for two years. This process brings about aeration, bacterial life, decomposition, and formation of humus. In some places lime and phosphoric acid is plowed under in the fall. A species of scrub pine is planted

with one of Norway spruce to two of pine. The pine requires very little air and soil moisture, aids in formation of humus, and protects the spruce. J. A. LARSEN.

Opsahl, Waldemar. *Indtryk fra en Studiereise gjennem de Danske Skoge.* Tidskrift for Skogbruk, 27:209-221.

Transplanting Tests

Experiments in grading and pruning transplant stock of Abies normandica and picea excelsa were carried out two years—1915 to 1917—at Silkeborg and Vemmetofte Forests. The results of these tests are given in great detail. Spruce: the large plants resist drought better than the medium and these again better than the smallest; unpruned stock gives always the largest per cent usable plants but the longest roots lie bent in the bottom of the hole or ditch. Differences in survival of the grades is less in a favorable than in a dry season. Light root pruning shows practically no difference in a favorable season, but may result in much loss of pruned stock in a dry summer and in poor growth. If the second season is moist the tops develop most and if dry the roots grow proportionately larger. Strong tamping of the soil in transplanting is useless. The third or smallest class of all seedlings should be discarded; foot pruning makes the work easier; the stock will stand more pruning on clay soil than on sandy soil; for use on the latter site pruning should consist in cutting the long straggling roots only. The results check well for both species. J. A. LARSEN.

Helms, Johs., and Paul Wegge. *Prikleforsög paa Silkeborg og Vemmetofte Skovdistrikter.* Det Forstlige Forsögsväsen i Danmark, 5:225-292. Pl. 41. 1920.

Tests of Climatic Varieties of Oak

Twelve experimental plantations have been made with oaks from Denmark, Holland, Russia, Moravia, Hungary, Selavonia, South Austria, and Hanover. These were started in 1909. The results to date show that none of the introduced varieties can be used with absolute certainty and that the oaks of Danish origin are best suited for local use. The oaks fram native seed are more robust and vigorous than those of foreign origin, their manner and time of development render them less liable to attack by mildew. The non-native oaks are generally more straight than the Danish variety, they

develop more summer shoots which are long and slender and with diminutive buds strongly infected with mildew, often they do not ripen at all and are therefore less frosthardy. Leaves of the Danish oaks develop later in the spring and discolor earlier in the fall.

J. A. Larsen.

Hauch, L. A. *Proveniensforsög med eg. II.* Det Forstlige Forsögsväsen i Danmark, 5:195-224. Pl. 6. 1920.

Storing Acorns Two Years

A considerable quantity of acorns which had been laid down in the fall of 1918 gave 40 per cent germination in 1920. The author concludes that in order to preserve the acorns two years it is necessary to use Hauch's method the first winter and to put the acorns down dry the following spring in a dry sand and to lay them so deep that temperatures remain fairly constant. J. A. Larsen.

Holten, A. *To-aarig opbevaring af agern.* Dansk Skovforenings Tidsskrift, 191-198. 1920.

BOTANY AND ZOOLOGY

Trees and Shrubs in Denmark

The Danish basswood is not generally a forest tree though it is among the earliest recognized arborescent in the country. Three species of basswood occur: (1) Tilia platyphylla Scop., T. grandifolia Ehrh. This species is here on the northern limit of its distribution. It entered Denmark during the warmer part of the post-glacial period and is now retrogressive both in Denmark and Sweden. (2) Tilia cordata, Mill. Syn.; T. ulmifolia Scop.; T. microphylla Vent.; T. parvifolia Ehrh. This is hardier and more of a forest tree and of more general distribution than the former. (3) Tilia cordata platyphylla; T. intermedia D. b.; T. europea L. A hybrid of rapid growth, vigorous but of limited distribution. It is used chiefly for shade trees and for parks. J. A. Larsen.

Ostenfeld, C. H. *Bemärkninger om Danske träers og buskes Systematisk udvidelse.* Dansk Skovforenings Tidsskrift, 164-182. Pl. 5. 1920.

UTILIZATION, MARKET, AND TECHNOLOGY

Timber Floating in Siam and Japan

The article is the result of three years' experience by Axel S. Sabroe in the Siamese teak forests in the employ of the East Asiatic Co., Ltd., of Copenhagen, and of an additional four months in Japan. He reports that the methods in both countries are adapted to the local conditions to such a degree that they differ widely from each other and from Swedish rafting. In Siam the writer was in charge of log driving in the creeks and of a station at Sawankaloke.

Rafting in Siam

In Siam the forests of teak (*Tectona grandis*) are found in the four old Laos States: Chiengmai, Lampang, Prae, and Nan. They are mostly deciduous and the teak is in mixtures with other trees, not forming pure stands. It occurs on the lower slopes of the low (1,000-1,200 m. above the sea) laterite mountains where the soil is moist during the rainy season. In the dry season, however, the soil becomes so dry that even the roots of the dead trees burn out, leaving holes in the earth.

The greatest part of the teak forests of Siam are divided for exploitation between five firms—four English and one Danish. A French firm is working near the northern boundary in the tributaries of Me Kong, but the many big waterfalls of this river make log driving so difficult that their output is not important. Some Siamese teak is driven down to Moulmein in Burma from the western mountains.

Girdling the standing trees is necessary to prepare teakwood for rafting, as it will not float green or when freshly cut. This is done by cutting about 10 cm. deep through the bark and sapwood. The dead trees are then left standing for at least two years, and many of them ten to twelve years, before felling. This long period is caused by the Forest Department requiring the trees to be girdled during four or five years of the concession in order to render its control effective. Trees over 6 feet 4½ inches in girth at breast-height may be girdled, provided there is at least one seed tree or three young plants within a distance of 120 feet. All girdling operations are inspected by English officers of the Forest Department assisted by native clerks. Artificial silviculture, as in Jawa, is practically unknown because the concessionnaires are uncertain as to the future (renewal of concession), and labor is a big handicap. The cuttings show good results in good soil, as the young

plants come on well when the old trees are felled. Owing to the early practice of girdling, on a large scale, middle aged trees before the Forest Department secured control in the nineties, the output of teak will be much smaller in thirty years. The present exploitation is reasonable as the over-ripe trees will be of no value if they are allowed to stand much longer.

It is impractical to use steam-donkey engines as in the United States of America, and without elephants these forests could not be worked at all. Usually a native elephant owner handles the work on a small creek. Felling is done by ax and saw. The logs are rolled down the mountains by the elephants and then dragged by them to the driving creek. Logs more than 14 m. in length are not permitted, because it makes driving in the creeks too difficult. The average dragging distances are 4-5 km. Sometimes in flat country the logs are transported in two-wheeled cars by 2-10 buffaloes or bullocks. Measurement and marking of the logs are done at the creek.

On the average it takes three years to float the timber down to Bangkok, but some logs from the remotest parts of the jungle are over 10 years on the way. Driving begins with the August rise which usually lasts but a few hours, and after it has receded the elephants are used to collect the strayed logs and place them in the main current. In a creek 35 km. long by air line, with a stock of 15,000 logs, 25 to 30 elephants are required to handle the work. In the main rivers it is impossible for the elephants to work during a rise, and here they can only straighten the timber during the dry season to make it ready for floating the next season and prevent damage by fire.

When the timber arrives at Central Siam it is made into rafts of about 170 logs (about 500 m^3 or 400 tons) to complete the journey to Bangkok. Canes are used for binding material and the rafts are cigar-shaped, about 140 m. long. They are provided with two oars in the bow for steering, and each raft has a crew of three men. In stopping, a man swims to the bank dragging the cane rope after him, fastens it round a tree or pole, gradually slowing the raft.

The rafting work is very difficult, as the current is strong and the stream crooked in many places. Each contractor usually takes only one raft down and arrives in Sawankaloke on Me Yome in the middle of August and beginning of September. In December the rafts are passed at the duty station at Paknampho, and 10 days later they arrive at Bangkok and are stored a short distance north of the town, where the tide does not make the water brakish.

The total output averages 100,000 logs at Paknampho and 20,000 logs at Moulmein (Burma) a year. The royalty and duty amounts to about £110,000.

Rafting in Japan

Log driving in the forests of Kiso in Central Japan is carried on when the water is low, directly opposite to that of Siam, which is done during the big rises of the creeks. This is because the Kiso forests contain mostly the valuable "Hinoki" (*Chamaecyparis obtusa*) which is easily damaged by the rocky creeks in high water. Furthermore, the logs are small in comparison with the Siamese teak logs and can therefore be driven in shallower water. The practice as developed has been in use for centuries. These forests (Kiso) belong to the Emperor of Japan and are the most intensively worked of the large forests of the country. They are 120-150 km. north of Nagoya and about 1,000 to 1,500 m. above sea level.

After felling in autumn and winter the logs are rolled on the snow down to the small creeks where flumes are made of them without using any nails or binding material. The rocky creek is thus turned into a sort of a staircase down which the timber is floated. Gradually the timber is worked down, one gang ahead making the flumes, the next floating the timber, while a third gang wrecks the upper end of the flumes and floats down the logs used in its construction. The work is done very cleverly without any other tool than the boathook used everywhere by timber floaters. These men get 20 cents (35 sen) a day and free rice. The work is very hard and they have to stand the whole day in cold water with only the "Tabi" (cloth sock) and straw sandals on their feet.

On arrival at the main river Kisogawa the timber is mostly landed near a railway station and forwarded by rail. Formerly it was rafted to Nagoya, but now only from the lower parts of the forests. The extension of narrow gauge railroads in the forests is gradually making log driving less important. However, it is still practiced on a large scale and is a beautiful example of a highly developed old-time method which is possible only with a large number of well-trained workers.

E. R. H.

Skogsvardsforeningers Tidskrift, 1919, Haft 12, pp. 281-304.

STATISTICS AND HISTORY

Norwegian Forest Service

This is a very complete and comprehensive report covering all forest activities for different sections of the country, it contains details of budget and accounts, timber cut, standing timber, reforestation, forest investigations, fungus and insect enemies and traveling scholarships. The total national forest area consists of 465,706 hectares Scotch pine and Norway spruce and 444,471 hectares, mostly of birch, oak, and alder. The total area burned in 1918 was 1,480 hectares, costing 22,006 kroner in fire fighting and a damage of 140,000 kroner. There were 1,040 moose, 1,139 deer, and 314 elk killed. The new Forest Experiment Station is under construction and the work in investigations is largely concerned with growth and yield. The year 1918 shows a total net receipt of 5,430,456 kroner.

J. A. LARSEN.

Det Norske Skogsväsen. Annual report for 1918. P. 125. 1920.

EDITORIAL COMMENT

The Annual Meeting of the Society

The annual meeting of the Society was held last year on December 20 in New York at the Yale Club. The educational conference that preceded the meeting as well as the twentieth Yale reunion that followed it, brought a large number of foresters to the meeting. It was therefore unfortunate that from a technical standpoint it did not provide a large field for the discussion of vital forest problems. Although the program contained many interesting papers there was no time for presenting them and little discussion of the few which were actually presented. The business meeting was more interesting as it generated considerable discussion and resulted in the adoption of many important resolutions. Resolutions, however, unless they are given wide publicity and acted upon remain mere paper resolutions. Let us hope that the new officers elected will see that the resolutions adopted at the annual meeting are made a basis for action. The usual lack of time for the discussion of technical problems and considerable interest manifested in the affairs of the Society as a whole raised the question of whether it would not be desirable in the future to separate the two parts altogether. The Society has now grown to large proportions with many varied interests and it certainly could devote at least one full day to a discussion of the Society affairs alone. An annual business meeting could be held at some convenient point most accessible to a large number of members. The technical meeting on the other hand, should be held in conjunction with the meetings of the American Association for the Advancement of Science where more time could be given to purely technical problems, where the members would have an opportunity to attend meetings of other societies, and where foresters could get in closer touch with the scientific workers in other allied branches.

The program of the meeting, as well as the resolutions, are printed elsewhere in the Journal.

Fire Protection Important But Not All

At the present time when in this country there is a strong movement on foot looking to a forestry program of greatly increased scope, and

when in this program the importance of fire protection is being stressed to such a great extent, the following note taken from *The Australian Forestry Journal* of October, 1920, in which the writer, Robson Black, is discussing conditions in Canada, will be refreshing to foresters who feel that insufficient emphasis is being given the subject of silviculture:

"Because much Government machinery has been brought into being for the mastery of the forest fire menace, one must not conclude that the plague is subdued. It will not be until the economic and moral senses of the population are considerably honed up by aggressive education. Fire protection, however, is merely a rudiment of forest management, corresponding to the purchase of a sprinkler system in the art of making motor cars. Each is fundamental, like good health and macadam roads. But fire protection is not sufficient to reconstitute the values in the denuded white pine or spruce forests of Ontario and Quebec. It is not alone sufficient to extend the life of the paper mills beyond the doleful 'fifty years' guessed at by so many manufacturers during the recent paper inquiry. It will not arrest the persistent crowding out of the white spruce by the quickly rotting balsam, nor will it maintain the supremacy of the coniferous trees over the less important hardwoods. This is the field of practical forestry."

NOTES

Forest Experiment Stations

Four bills were introduced in Congress during December, 1920, providing for the establishment and maintenance by the Forest Service of Forest Experiment Stations. The maintenance of the station in Colorado is the subject of bills (S. 4676) and (H. R. 14477) introduced in the Senate and House of Representatives by Senator Phipps and Mr. Timberlake, respectively. The bills carry an appropriation of $30,000 for the year ending June 30, 1922. They were referred to the Senate and House Committees on Appropriations. Their purpose is provision for experiments to determine the most satisfactory methods for managing forests and forest lands in Colorado and neighboring States.

The Fremont Experiment Station near Colorado Springs was established in 1909. It has never been adequately supported but in spite of this handicap valuable results have been obtained. The passage of these bills would provide for putting the work on a basis where a large volume of valuable data could be turned out, just at the time when the realization of the seriousness of the timber situation in the United States makes the need for reliable information especially urgent.

A third bill (S. 4611) was introduced in the Senate by Senator Ransdell of Louisiana providing for a forest experiment station in the Southern States at a suitable place to be selected by the Secretary of Agriculture. It carries an appropriation of $50,000 for expenditure during the year ending June 30, 1922. It was referred to the Committee on Agriculture and Forestry. The purpose of the station as stated in the bill is to determine the best methods for the conservative management of southern pine and other forests and forest lands and the production of timber, naval stores, and other forest products in the Southern States.

Last winter Senator Fletcher of Florida introduced a bill (S. 3946) providing $50,000 for a forest experiment station on the Florida National Forest. These two bills are an indication of a real interest in and need of experimental work in forestry in two of the most important southern timber States.

The fourth bill (S. 1703) was introduced by Senator McNary of Oregon and carries an appropriation of $50,000 for a forest experiment station in Oregon or Washington. With 50 per cent of the remaining timber in the United States on the Pacific Coast, and the prospect that the whole country will soon be looking toward this one last source of supply, the importance of initiating in time the experimental work upon which to base the continued productiveness of this timber reservoir is evident.

Relative Durability of Idaho Woods

The experiments conducted by Dr. Henry Schmitz and Mr. A. S. Daniels, of the School of Forestry of Idaho, concerning the durability of the commercial woods are practically completed and, although it is a little early to draw final conclusions, some very interestng results are evident.

The various woods have been subjected to the action of ten typical wood destroying fungi for approximately one year. The list of fungi includes the more common and important timber decaying forms found in this region as for example: Fomes pinicola, Echinodontium tinctorum, Lenzites saepiaria, Lentinis lepidus, and others.

The results so far indicate that white fir is far more resistant to decay than generally thought and white pine is quite susceptible to decay. The average loss in weight for white pine is approximately 16 per cent, that of yellow pine 11 per cent, white fir 4 per cent, and Englemann spruce 5 per cent.

It is hoped to carry on similar experiments with these same woods under natural conditions and if the same relationships hold, the use for the so-called inferior species may be greatly extended and a more intelligent use of the various species will be possible.

State Foresters Favor State Control

As a result of a conference of State Forestry officials held at Atlantic City November 12 to 13, 1920, for the purpose of considering the question of national forestry legislation, and attended by officials from sixteen of the thirty-four State Forestry Departments, we, the undersigned, as heads of the Forestry Departments in our respective States, fully endorse the recommendations of the U. S. Forest Service relating

to co-operation with States in fire protection and forest renewal, as embodied in the report on Senate Resolution No. 311, known as the "Capper Report."

We therefore urge upon Congress the enactment of the legislation necessary to make those recommendations effective, accompanied by suitable annual appropriations, which, for the fiscal year ending June 30, 1922, should not be less than one million dollars ($1,000,000), to be expended by the Secretary of Agriculture in co-operation with the several States, for forest fire prevention and control, forest investigations, and timber production including forest planting.

Signed by the State Foresters of—

Alabama	Maryland	Ohio
Connecticut	Massachusetts	Oregon
Illinois	Michigan	Texas
Iowa	Montana	Virginia
Kansas	New Hampshire	West Virginia
Louisiana	New Jersey	Wisconsin
Maine	New York	

Second Educational Conference Sends Greetings to Dr. Fernow

Representatives of thirty forest schools, assembled at New Haven for the second conference on forest education, unite in sending you an expression of appreciation for your great services to the profession and to the country as founder and dean of forestry education in America. J. W. Toumey.

Fernow's Reply

Highly appreciating the complimentary message of the Conference. The accident of priority puts me in the place where the Conference placed me. Wishing success to their deliberations.

B. E. Fernow.

Sowing Seed of Deep Tap-Rooted Hardwoods

Mr. C. C. Deam, State Forester of Indiana, suggests that before carrying on field sowing operations with a deep tap-rooted hardwood species such as chestnut, the oaks, hickories, and black walnut, the seed should be immersed in a tub of water and stirred vigorously so that all of the lighter seed will have an opportunity to come to the

surface. He finds that not only the poorly developed seed but also those which are wormy do come to the top. When they are removed practically all of the remaining seed are of good quality. When the heavy walnut and hickory are sown, it has been Mr. Deam's experience that nearly all of them will sprout. The same is not always true with the oaks. Some of the heavier oaks do not sprout.

Provision for a Forest Experiment Station in Arizona

The establishment and maintenance of a Forest Experiment Station in Arizona under the direction of the Forest Service is provided for in a bill (S. 4776) recently introduced in the United States Senate by Senator Ashurst of Arizona. The bill carries an appropriation of $30,000.

This is a good indication of the awakening interest of the people in the Southwest in the value and the need of perpetuating their local timber resources. Already the region is not self-supporting in timber and wood products and the demand is certain to increase with the rapid agricultural development on irrigated lands. A forest experiment station will work out the best methods of protecting, reproducing, and increasing the productiveness of one of the most important natural resources of the Southwest.

The Secretary of the New York Section, Nelson C. Brown, writes that the members located in and about New York City are meeting regularly the first Thursday of each month at 1 p.m. at the Yale Club for luncheon and that all foresters that happen to be in New York the first Thursday of each month are indeed welcome to join them, if they will kindly notify or telephone the Secretary at 506 Hudson Terminal, 30 Church Street, New York (Courtlandt 1556). The following foresters have been meeting heretofore and some excellent discussions have been held: J. E. Rothery, B. Moore, E. A. Sterling, H. P. Baker, and R. S. Kellogg.

SOCIETY AFFAIRS

Papers Read at the Annual Meeting

The program for the annual meeting of the Society included the following papers which were to be read. Of these, however, only five were actually presented and only two were discussed. The rest were merely read by title.

Report of the President

December 20, 1920.

The last two years of the Society's existence have been noteworthy for at least one thing, namely, that the Society as an organization has emerged from a state of lethargy into one of action. For the first time in its existence the membership of the organization was called upon to express its opinion on a vital national question. The result of the vote on the Report of the Committee on the Application of Forestry was conclusive, in spite of any contention which may be made that it was not representative. We are justified in assuming that those who were firmly opposed to the report voted, as also did those who were strongly in favor of it. Since in addition to those mentioned, there were many votes vast by members who had no active part in the campaign either for or against the report, we can only assume that they cast their ballots after having carefully weighed

the question and that they expressed their real sentiments in so doing.

We must not fail to bear in mind that the total vote cast at the time the report was under consideration was fully as great as that cast at the average annual election and the failure of an appreciable portion of the membership to express an opinion on the matter is in accordance with past procedure. It is unfortunate that the membership as a whole does not exercise its voting privilege. If any of you can offer a satisfactory solution of the problem, I am sure it will be greatly appreciated by the officers and the Executive Council of the Society.

The Society has expressed itself on the first real issue that has been before it and it now remains for your officers to put into action the will of the Society. This, I hope, will be done in the near future.

The past year has seen a marked increase in the membership of the Society and there are, I believe, a relatively large number of names now under consideration by the Executive Council. The campaign for members should be actively continued until the Society embraces within its membership a large per cent of the foresters of the country. I have had occasion recently to compile data regarding forest school graduates in this country. I find that more than 2,000 degrees have been granted in forestry in the United States during the last twenty years. There is reason to believe that fully 60 per cent of these men are engaged in forestry or closely allied lines and are eligible for membership.

The Society needs these men and I am sure they will derive much benefit from membership in the Society. Let each member therefore do what he can to bring before the Executive Council the names of all those who are eligible. In this work, the various Sections should be the leaders.

Mr. Dana as Chairman of the Committee on Admissions of the Executive Council has performed his task most painstakingly and well, and to him our thanks are due, because the work of preparing and circulating the data on names proposed for membership requires much time.

My personal conviction is that in the end it will prove more satisfactory for the Society to elect new members either at semi-annual or annual periods only, preferably the latter. This will give ample time to prepare the credentials and, I think, will prove a more satisfactory plan than the present scheme of passing on men whenever a reasonable number of candidates have been proposed.

I also suggest a change in the procedure followed in handling membership elections, namely, that a separate ballot and a separate set of credentials be forwarded to each member of the Executive Council, in order that the election may be expedited and also that there may be no possibility of having the credentials mislaid. This will involve additional stenographic service which the Society should glady meet, because of the greater efficiency which will result. This method has this further advantage, namely, that the individual members of the Executive Council will not be influenced in their decision by the vote of any of the other members.

A problem which the Society should consider today is the place at which the annual meetings shall be held. During some of the previous years, it has been held in conjunction with the American Association for the Advancement of Science—a very satisfactory arrangement for many members who are interested not only in the forestry group but also in some of the other groups. Some of the Western members suggested the desirability of holding the annual meeting in Chicago next week in connection with the above association. They feel that they might have been able to attend the Chicago meeting but that a New York meeting was out of consideration.

There is a large measure of justice in their claim and every effort should be made to make the meetings equally accessible both to Eastern and Western members. The request for a change to Chicago came too late, since plans had already been made, but I feel that the Society should today take some action with reference to this matter.

The Committee on Meeting and Program deemed it advisable to hold the meeting in the East this year because of the promise of a relatively large group of Western men who reported their intentions of being in the East at this time to attend a Yale Reunion.

It may prove advisable and necessary, in order to accommodate our widely scattered membership, to hold a business meeting in some city where a relatively large attendance can be secured and to authorize and encourage another meeting in connection with the A. A. A. S., the program for which shall be in charge of the Section in whose territory the meeting is to be held. A thorough discussion of this question, with such action as you may deem advisable, will save from embarrassment future committees having charge of arrangements for the annual meetings.

The question of the election of Fellows to the Society has been to the fore during the last few months and a list of some fifty names submitted to the Executive Council for action. For failure to elect Fellows each year the Society has been branded by some as being in a comatose condition. This feeling is due probably to a misapprehension of what the grade of Fellow should stand for in a technical society such as ours.

The chief object for which the grade of Fellow was created was to serve as a mark of distinction for those men in the profession on whom we wished to confer the highest honor in our power. In order to fulfill this mission it must be confined to a very limited number of the profession whose work stands out preeminent—otherwise there is no special honor attached to election to this grade. The Society, therefore, should move slowly in the election of members to the grade of Fellow, in order that such election may be regarded as a real honor.

The President of the Society has within the last few weeks been asked by the Director of the Bureau of Standards to appoint a member to serve on a committee to revise a tentative safety code on logging and sawmill work. I have appointed on this committee, E. T. Clarke, Professor Logging Engineering, University of Washington. For some years he has given much time and thought to this question and I am sure will prove a very able member of the committee. Any members of the Society who are interested in the question of safety standards can secure a copy of the present tentative code from the Director of the Bureau of Standards. It is requested that those of you who have suggestions to make get in touch with Clarke and make arrangements to furnish him the data so that he may prepare such material on the subject as the members desire to bring before the committee.

At the conference on Forestry Education which closed at New Haven on Saturday and at which more than thirty institutions teaching forestry subjects were represented, a resolution was passed requesting the Society to stand sponsor for an Educational Committee which shall continue the work of the conference and be the clearing house for educational matters for the profession. The idea is an exceedingly good one and I hope that the Society will approve the request of the conference. An opportunity is here presented not only to further forestry education in this country but also to promote research within the profession.

In connection with research, I wish to call the attention of the members to the recent report on the subject published by the National Research Council, which was prepared under the direction of the chairman of the Research Committee of the Society.

Since the completion of the report, the Research Committee has not functioned because of the resignation of the chairman. A new committee was not created, because it was felt that for the time being the interests of the Society in research could be satisfactorily handled by an active committee within the N. R. C., the majority of the members of which were also members of the Society. If the request of the Educational Conference is approved, research matters will presumably be handled through the Educational Committee.

There has been a gratifying interest manifested by the various Sections in the work of the Society during the past year. They promise to be a potent force in creating greater interest in the Society as such, and in forestry in general in their respective regions.

I here want to appeal to each Section to do what it can to bring home to the members the desirability and necessity of each man recording his personal opinion on questions at issue, instead of remaining a passive onlooker as many seem to do today. It is scarcely conceivable that only about one-half of the membership have any decided opinions about who should conduct the affairs of the Society, yet such appears to be the case. The Society can never take the place it should in the development of the profession until a majority of the members become sufficiently interested at least to record their choice of officers.

I would like to suggest the desirability of having a Committee on Sections, composed of the chairman of existing Sections, the duty of which should be a survey of the field to determine where new Sections if any should be organized, and to make plans for the coordination, as far as is deemed practicable of the present work of Sections and to outline any new activities which may appear desirable. I feel that such a committee during the coming year may do much to make the Society a more virile organization.

I want to express to the officers of the Society and to the members of the Executive Council, my hearty thanks for the generous support which they have accorded to me the past year.

We have tried to uphold the high ethical standards which have always marked the conduct of Society affairs in the past and have en-

deavored to keep an open mind on all questions which affected the interests of the organization.

The JOURNAL OF FORESTRY'S pages have been open to all sides in a discussion of the national forest policy, and if the JOURNAL has failed in any case to publish material submitted to it, you may rest assured that it was due to the inadequate financial resources of the publication which necessitate the most careful attention to the number of pages of material which enter each issue. That the JOURNAL should be forced to rigidly limit itself as to size is unforunate, but until the Society gets on a more substantial financial footing than it is today, this is the only course which is open to those in charge of the JOURNAL OF FORESTRY.

R. C. BRYANT.

REPORT OF THE SECRETARY FOR 1920

December 20, 1920.

The membership of the Society is as follows: Fellows, 6; Senior Members, 356; Members, 47; Associate Members, 65; Honorary Members, 12; making a total of 486. There will be an increase in these numbers when final action is taken on the recent nominations.

Twelve Sections of the Society have now been organized and are functioning. The New England and Pennsylvania Sections are the additions. Formal organization of the Southeastern Section has not yet been accomplished although authority has been granted by the Executive Council.

There has been a marked awakening of interest in the affairs of the Society judging from the number and character of communications that were addressed to the Secretary during the year.

It may be of interest to the members to have their attention called to one phase of such awakening. It occurred in connection with the annual election. This can perhaps be best shown if we consider the vote in terms of percentages. In doing this I am not establishing a new line of reasoning. I am merely following a guide post set up for us during the past year. As you may remember in the discussion of the participation of the membership in a matter put before it, it was indicated that "the Society has never polled a vote greater than 60 per cent of its total voting membership, and it reached that percentage only once. The average total vote has run along between 40 and 50 per cent of the total membership."

In the annual election of 1920 a total of 71 per cent of the voting membership participated. Surely a healthy sign!

The tellers appointed by the President have certified to the Secretary the following election results: President, R. C. Bryant; Vice President, P. G. Redington; Secretary, P. D. Kelleter; Treasurer, E. H. Frothingham; Member Executive Council, R. Zon.

PAUL D. KELLETER.

REPORT OF THE TREASURER FOR 1920

It has only been with the helpful cooperation of the Editor that the finances of the Society have been sufficient to carry on the work of the JOURNAL during the past year. The increased cost of publication has made it necessary for him to restrict the size of some of the issues and delay the publication of certain articles.

It will be seen that the figure given in the following table for the publication and distribution of the JOURNAL ($5,147.82) includes $1,148.83 for the printing of the last two issues of the preceding volume. The average cost of printing and distributing the ten issues covered in the present report was $514.78 for each issue. This is an average cost per copy of 43 cents as compared with 38 cents last year and 32 cents the previous year. In other words the cost has increased 33 per cent during the two years, in spite of the fact that the size of the magazine has been somewhat reduced. In this connection it should be mentioned that bids were secured from printers in Baltimore, Philadelphia, and New York, but none were as satisfactory as that of the Washington printer to whom the work was given.

The receipts from advertising and from the sale of back numbers of the magazine have increased encouragingly. The increase in the subscription rate which was voted on at the last annual meeting will be a greater source of revenue during the coming year than it was last year, because the change did not go into effect until most of the subscriptions had been paid. The excess of assets over liabilities is $797.85 as compared with $643.21 at the beginning of the year.

On the whole the finances of the Society are in better condition than they were a year ago, and unless the cost of printing continues to advance, it should be possible to increase the size of the magazine and the usefulness of the Society.

RECEIPTS

Balance on hand Jan. 1, 1920				$2,076.72
Annual dues:				
1918		$20.00		
1919		58.27		
1920		1,800.25		
1921		20.00		
			$1,898.52	
Subscriptions to JOURNAL:				
1919, Vol. 17		$22.00		
1920, Vol. 18		1,751.60		
1921, Vol. 19		155.97		
1922, Vol. 20		10.00		
			1,939.57	
Sale of back numbers:				
JOURNAL and reprints		$257.18		
Proceedings		40.60		
Forestry Quarterly		75.25		
			373.03	
Advertising:				
By commercial institutions		$148.75		
By educational institutions		173.00		
Miscellaneous		3.00		
			324.75	
Society pins			21.30	
Miscellaneous:				
Interest on bank deposit, 1920		$31.90		
Gift to the Society		20.00		
Refund by author for unused article		18.00		
Refund for bill paid twice		17.64		
			87.54	
Total				4,644.71
Grand total				$6,721.43

DISBURSEMENTS

Publication and distribution of JOURNAL:				
Printing—				
Vol. 17, Nos. 7-8	$1,148.83			
Vol. 18, Nos. 1-8	3,289.09			
		$4,437.92		
Line cuts and plates		54.91		
Proofreading		225.00		
Envelopes		300.20		
Postage		115.74		
Stencils		14.05		
			$5,147.82	

Miscellaneous printing:			
Ballots	$110.25		
Programs and announcements	14.00		
Membership cards	7.65		
		131.90	
Stationery and postage (exclusive of JOURNAL):			
Stamped envelopes	$54.96		
Post cards	5.00		
Stamps	92.38		
		152.34	
Clerical and stenographic work		277.00	
Operating addressograph machine, etc		11.75	
Telegrams and telephone calls		8.24	
Express		2.84	
Society pins		21.00	
Miscellaneous:			
Refunds on subscriptions, gifts, etc	$31.67		
Dr. Fernow (Quarterlies sold 1919)	83.50		
Repairs to addressograph machine	1.30		
Bad checks returned by bank	8.00		
Room rent for N. Y. meeting	6.00		
		130.47	
Total			$5,883.36
Balance on hand			838.07
Grand total			$6,721.43

ASSETS

Balance on hand		$838.07	
Annual dues:			
Twenty-nine at $5.00	$145.00		
Two at $4.00	8.00		
		153.00	
Sales of back numbers		29.50	
Advertising		74.50	
Total			$1,095.07

LIABILITIES

Subscriptions paid in advance	$164.97	
Dues paid in advance	20.00	
Clerical and stenographic work	30.00	
Dr. Fernow (Quarterlies sold in 1920)	75.25	
Postage, express and telegrams	7.00	
Total		$297.22
Excess of assets over liabilities		$797.85

AUSTIN F. HAWES, *Treasurer.*

Audited and found correct by W. B. Barrows.

Report on Admissions

NEW MEMBERS

During the past year 206 persons were elected to membership in the Society. This number includes 159 Members, 36 Senior Members, 7 Associate Members, 2 Honorary Members, and 2 Corresponding Members, as follows:

MEMBERS

Adams, A. C.
Agee, Fred B.
Amadon, Arthur F.
Andrews, Frank E.
Arentson, Carl B.
Arrivee, David A.
Arthur, O. Fred
Avery, B. F.
Ayers, B. K.
Ayres, R. W.
Bailey, H. V.
Baker, C. B.
Baldwin, W. L.
Barker, William L.
Barrett, L. A.
Baum, A. M.
Beatty, D. L.
Behre, Charles E.
Benedict, M. A.
Bigelow, R. L. P.
Bonney, P. S.
Borden, Harold L.
Boyce, Charles W.
Bremicker, Joel H.
Bright, George A.
Brooks, A. B.
Brown, Vance S.
Brundage Marsden R.
Burns, John D.
Buttrick, P. L.
Cary, N. Leroy
Chapler, R. H.
Claridge, B. E.
Clark, C. R.
Clark, Donald H.
Clark, Robert E.
Cleator, Fred W.
Colgan, Richard A.
Conner, James F.
Conover, Charles J.
Cook Irwin W.
Cope, J. A.
Coulson, E. H.
Dahlgren, C. A.
DeCamp, Lee R.
Delavan, C. C.
Doherty, W. L.
Dorward, D. L.
Douglas, Lynn H.
Dunning, Duncan
Durbin, W. G.
Eaton, C. W.
Edwards, William G.
Ericson, O. F.
Evans, Charles F.
Favre, Clarence E.
Fletcher, E. D.
Flint, H. R.
Flintham, Stuart J.
Foran, Harold G.
Gamash, A. W.
Gery, Raymond E.
Goodwin, James L.
Gould, C. W.
Graham, S. A.
Haefner, H. E.
Haines Roscoe
Hall, Ansel F.
Hamel, Albin G.
Hammer, George C.
Hansen, T. S.
Harris, Harvey W.

Harris, S. Grant, Jr.
Hicock, Henry W.
Hope, Luther S.
Hoyle, Raymond J.
Huestis, W. A.
Hult, G. W.
Hunter Gerald M.
Hutton Andrew
Jensen, Christian
Jones, E. F.
Johnston, Herbert W.
Jotter, Walter E.
Kavanaugh, Edward N.
Kelley, E. W.
Ketridge, J. C.
Kitchin, P. C.
Knouf, C. E.
Koehler, Arthur
Krueger, Myron E.
Krueger Theodore
Lee, J. G.
Lentz, G. H.
Leve Walter H.
McCarthy, W. J.
Mains, Guy B.
Marckworth, Gordon D.
Moss, Albert E.
Miller, Edward G.
Moir, W. Stuart
Monell, G. R.
Nagel, W. M.
Naramore, David C.
Neal Carl B.
Olson, D. S.
Oppel, Arthur F.
Paeth, William J.
Paine, F. R.
Palmer, Lawrence J.
Parsons, R. H.
Pearce, Wallace J.
Peck, Edward C.
Peck, Ray
Plumb, H. L.
Pooler Frank C. W.
Porter, G. I.
Porter, Oliver M.
Rachford, C. E.
Ramsdell, Willett F.
Rendall, Raymond E.
Richey, Alve L.
Rook, John C.
Roeser, Jacob, Jr.
Ross, R. M.
Rutledge, R. H.
Sanford, Burnett
Schmitz, Henry
Schrader, Walter H.
Schreck, Robert G.
Schwab, W. G.
Shelley, R. S.
Shoemaker, David A.
Sifferlin, Charles E.
Smith, G. A.
Smith, R. E. Kan
Sproat, Will J.
Staebner, R. C.
Steuart, Charles
Studley, J. D.
Sutton, C. E.
Swartz, U. S.
Sweet, C. V.
Tanner, Earl B.
Taylor, Clarence E.
Tinker, Earl W.
Wahlenburg, W. G.
Watson, Clarence W.
Weber, H. G.
Wheeler, Herbert N.
Whitney, C. N.
Wieslander, Albert E.
Wiggin, G. H.
Wilcox, Arthur R.
Wilcox, Herbert F.
Wilson Stanley F.
Wood, Arthur P.
Wright, Newell L.
Zeller, Robert A.

SENIOR MEMBERS

Anderson, Clarence R.
Baker, H. L.
Baker, W. M.
Barrows, W. B.
Belyea, H. C.
Bishop, Loren L.
Boyce, J. S.
Condon, H. R.
Evans, R. M.
Fitzwater, J. A.
Griffin, Alfred A.
Hall, E. H.
Higgins, Jay
Hornby, L. G.
Kaplan, J. S.
Keplinger, Peter
Kraebel, Chas. J.
Krell, F. C.
Marsh, S. H.
Morrill, W. J.
O'Byrne, J. W.
Parker, Gordon
Pfeiffer, Karl E.
Prentice, Burr N.
Russell, H. L.
Simmons, J. R.
Smith, S. D.
Spencer, John W.
Stewart, Sydney S.
Thompson, S. H.
Watson, Russell
Watts, Lyle F.
Weidman, Robert H.
Willey, W. B.
Woods, John B.
Wyman, Lenthall

ASSOCIATE MEMBERS

Bazeley, W. A. L.
Blair, R. J.
Brown, W. R.
Fowler, F. H.
Slattery, Harry A.
Thelen, Rolf
Wiley, C.

HONORARY MEMBERS

Lovat, General Lord, K. T., K. C. V. O., K. C. M. G., C. B., D. S. O.
Sutherland, Col. John, C. B. E.

CORRESPONDING MEMBERS

Joubaire, Lt. Col. Armand
Leete, F. A.

This constitutes the largest number of persons ever elected to the Society in a single year. An interesting point is the very large number of Members elected as compared to Senior Members. This apparently indicates that the great majority of those qualified for Senior Membership have already been elected to that grade and that from now on the bulk of the men will be elected to Membership, with the prospect of advancement later to Senior Membership as their achievement in the profession warrants the change to the higher grade.

In this connection attention should be called to the fact that sixteen of those included in the above list as elected to Membership were nominated and received one or more votes in the Executive Council

for Senior Membership. These names are all being re-considered with the probability that some of them at least will be elected to Senior Membership. They are, however, being regarded as elected to Membership at once in order to avoid any delay in effecting their affiliation with the Society.

The election of our first Corresponding Members, one from France and one from India, under the recently adopted amendment to the constitution providing for this grade of membership, is of considerable interest. The Council feels that the number of Corresponding Members should be kept comparatively small and should be limited to those who are really interested in the Society and its activities, and will therefore add to its strength. At the same time it believes that it would be desirable to keep the Society more closely in touch with forestry in other parts of the world by having at least one or two Corresponding Members in countries in whose activities we are interested. A list of candidates which will be published in the near future will contain the name of a Norwegian forester, and it is suggested that members consider foresters of other countries who might well be proposed for this grade.

CONSTITUTIONAL REQUIREMENTS FOR MEMBERSHIP

Present constitutional requirements for the different grades of membership are as follows:

"(1) *Members*, who shall be—

"(*a*) Men who have completed not less than four years of college work leading to a degree in forestry, or its equivalent in technical forestry training; or

"(*b*) Men without collegiate training in forestry who have completed at least three years' work of a creditable character in some branch of forestry.

"(2) *Senior Members*, who shall be foresters engaged in forest work and—

"(*a*) Who have completed technical training in forestry at a forest school of recognized standing, together with at least three years' work of a creditable character in some branch of forestry; or

"(*b*) Who have, in the absence of technical training in forestry, completed at least five years' work in some branch of forestry, who have been members of the Society for at least two years, and whose work is regarded by the Council as of an especially creditable character.

"(3) *Fellows,* who shall be elected only from the grade of Senior Member. Fellows shall have completed at least ten years' work in some branch of forestry, including at least five years in responsible directive positions or in distinctive individual work of a fruitful character.

"(4) *Associate Members,* who shall be persons engaged in lines of work related to forestry and who have shown substantial interest in American or Canadian forestry.

"(5) *Honorary Members,* who shall be chosen from those who have rendered distinguished service to forestry either in America or abroad, and from professional foresters of achievement whose field of work lies outside of the United States and its possessions and the Dominion of Canada.

"(6) *Corresponding Members,* who shall be foresters not residents of the United States, or its possessions, or of Canada. They shall have the qualifications requisite for Senior Members, and shall be entitled to all privileges of the Society except voting."

MEMBERSHIP POLICY OF EXECUTIVE COUNCIL

The May, 1919, issue of the JOURNAL OF FORESTRY contained a statement indicating the tentative policy adopted by the Executive Council in applying these constitutional requirements to the election of members of various grades, with the request for comment and criticism. During the past year a thorough review of this statement was made by the Council in the light of its own experience and opinions and of the discouragingly few comments received. As a result of this review the following revised statement of policy has been prepared and will be followed by the Council in the handling of admissions until further notice:

1. Members and Senior Members must be foresters and must be actually engaged in forest work at the time of election to the Society. Distinction between the two grades is based entirely on experience and achievements, the fundamental requirements as to training and character of work being the same for the two grades.

2. "Foresters" are (*a*) Men who have completed not less than four years of college work leading to a degree in forestry, or its equivalent in technical forestry training; or (*b*) Men without collegiate training in forestry who have completed at least three years' work of a creditable character in some branch of forestry, and who have acquired a

thorough understanding of the aims of forestry and a general knowledge of its methods.

3. "Forest work" covers the four main fields of forest management, forest protection, forest administration, and forest and wood utilization, and may include specialization in any one of these fields, provided such specialization is closely linked up with forest production. Thus logging engineering, wood technology, forest economics, forest entomology, forest pathology, and grazing as related to forest management are all regarded as forest work.

4. Neither practical experience nor achievement is necessary for admission to Membership. The general policy is to include in this grade practically all forest school graduates and others who qualify as foresters and who are engaged in forest work. Original election to the Society will ordinarily be to this grade rather than to Senior Membership.

5. Senior Membership is regarded as a higher grade than Active Membership under the old constitution. Election to it will be based on achievement, which may be indicated by advancement to a position of responsibility and a noteworthy showing of efficiency in any line of forest work, by some definite and important contribution to the advancement of forestry, or by authorship of creditable publications on some phase of forestry. Experience alone, when involving no more than a routine and satisfactory performance of customary and directed duties, is not sufficient. Change from the grade of Membership to that of Senior Membership is not automatic, and there will doubtless be cases where men will remain indefinitely in the Membership grade. This will be increasingly true as standards for Senior Membership are made more strict with the growth of the profession.

6. It is the belief of the Executive Council that a comparatively small number of men should be chosen as Fellows, so as to make election to this grade a distinct honor. In addition to such nominations for Fellows as may be made by the written endorsement of 25 Senior Members or Fellows, the Executive Council will from time to time review the list of Senior Members to make certain that no men who, in its judgment, qualify for this grade have been overlooked. Nominations by the Executive Council will ordinarily be limited to a few names.

7. Associate Membership is limited to persons "engaged in lines of work related to forestry." "Substantial interest" in forestry must also

be shown, and candidates must be men who are rather generally known to the profession.

8. The Council feels that foresters engaged in forest work in America who have rendered distinguished service to forestry should be honored by election as Fellows rather than as Honorary Members, in spite of the fact that the constitution would permit of their election to either grade.

9. The requirement of the constitution that "except as specified for Honorary Membership and Corresponding Membership, members of the Society shall be residents of the United States, or of its possessions, or of Canada" is interpreted as meaning legal residence and not actual residence at the time of election. Thus an American forester temporarily residing in some other country is still eligible for election to Membership or Senior Membership in the Society. Furthermore, anyone already a member of the Society who might leave the United States, its possessions, or Canada to take up work elsewhere would not thereby surrender membership in the Society. This applies also to men going into other lines of work after election. If these men so desire there is no reason why they should not continue indefinitely their connection with the Society.

10. With the single exception as to place of residence, the same qualifications are required for Corresponding Membership as for Senior Membership. The Council feels that the number of Corresponding Members should be kept comparatively small, and urges members to limit nominations to this grade to foresters in other countries who will take a real interest in and add strength to the Society.

11. All proposals of candidates must be endorsed by at least three Senior Members or Fellows (or a Section), and must contain the following information:

(*a*) Full name and grade for which proposed.

(*b*) Educational institutions attended, with degrees received and dates. In the absence of a degree in forestry satisfactory evidence must be furnished that the candidate is a forester as defined in paragraph 2 above.

(*c*) Detailed statement of practical experience in forest work, chronologically arranged, with a summary of principal activities by lines of work.

(*d*) List of important publications, with a summary of their general character and value.

(*e*) Detailed statement of achievements, particularly for Senior Membership.

(*f*) Present position, character of work, and postoffice address.

12. In cases where a man resides in a region covered by a Section of the Society, it is desired to have his name passed upon by the Section as a whole rather than by a few individuals in it before being submitted to the Council for action. In cases where this is not done, the Section will ordinarily be asked by the Council for an expression of opinion. Nominations by Sections should be accompanied with information as to the number of votes cast for and against each candidate and, preferably, with reasons for any negative votes.

13. Former members of the Society, whether or not in good standing at the time of their separation from it, must be re-elected according to the usual procedure after referring their names to all Senior Members and Fellows for comment or protest. The re-election of former members who were dropped for non-payment of dues will not become effective until they have paid the Society the amount of their arrears at the time of their separation from it.

14. The names of candidates for admission to the Society will be published under the grade for which they are proposed by their endorsers. The Member of the Executive Council in Charge of Admissions may suggest to a candidate's endorsers any change in grade that appears to him advisable, but has no authority to make such change on his own initiative.

15. Candidates for Senior Membership may be elected by the Council to Membership if in its judgment they do not qualify for the higher grade. In all other cases where the Council believes that a candidate should be elected to a different grade than that for which he has been proposed, it will take the matter up with his endorsers with a view to having the original nomination changed. Actual election to the new grade will not take place until the man's name has been published as a candidate for it and opportunity for comment or protest thus offered to all Senior Members and Fellows.

16. Since it is impossible for the Executive Council to meet for the discussion of candidates, its first ballot on each candidate is regarded as final only when it is unanimous. In case any difference of opinion develops as to the grade to which a candidate should be elected, a second ballot is taken. This second ballot is regarded as final unless it develops some new point of importance which has not previously

been brought out, in which case the name of the individual is resubmitted for further consideration.

17. The right to wear the Society badge is limited to Members, Senior Members, and Fellows.

Members are reminded that this statement of policy is subject to revision from time to time and are urged to submit their views regarding it, whether in approval or disapproval. The Council is desirous of following the wishes of the majority of the Society in the handling of membership matters, but is obviously handicapped in doing so unless it knows what those wishes are.

The most important change in the present statement as compared with that in the May, 1919, issue of the JOURNAL OF FORESTRY is in the definition of "forester." The previous definition required that men without forest school training must have acquired the equivalent of such training in other ways and covering particularly the fundamental subjects of silviculture and forest management. Experience has shown that this alternative is practically impossible of fulfillment. The new definition establishes a criterion which can reasonably be met and which at the same time will not lower the standing of the profession. Attention is particularly called to the fact that candidates must both be foresters and actually in forest work at the time of their election to the Society.

Another change of importance is the interpretation of the provision that "except as specified for Honorary Membership and Corresponding Membership, members of the Society shall be residents of the United States, or of its possessions, or of Canada" as meaning legal and not actual residence at the time of election to the Society.

Considerable difference of opinion has arisen, both within and without the Council, as to how far the Society should go in electing to membership men who are not forest school graduates and who are in a line of forest work (broadly defined) not dealing directly with forest production. This question has come up particularly in connection with the field of forest products, but applies also to such fields as forest recreation, park and city forestry, and even lumbering. Another point of difference is as to whether men should be elected to Membership immediately on the completion of a four-year course in forestry, or whether an additional year, spent either in practical work or in study leading to an advanced degree, should be required. Members are urged to submit their views on these two points in order to assist the

Council in adopting a policy which will meet the approval of the Society generally.

During the latter part of the year the question of Fellowship received considerable attention from the Executive Council. After a thorough consideration of the entire matter, including two ballots for the nomination of Fellows, the Council agreed that in its judgment nominations and elections to Fellowship should be limited to those of marked distinction whose standing as leaders in the profession is undisputed. If the grade of Fellawship is to have any real meaning either for those within or for those without the Society, the Council feels that the high standard set by the Society in the only election for Fellows so far held should be maintained. In accordance with this policy only one Senior Member has been nominated by the Council for Fellow. In addition five other Senior Members have been nominated by the written endorsement of 25 Senior Members or Fellows, and it is understood that petitions for the nomination of still others are now being circulated. The Society as a whole will thus have an opportunity in the near future, in balloting on the names of those nominated, to make known its views in the matter.

CANDIDATES FOR ADMISSION

In addition to the 206 new members elected during the year, the Council has under consideration 22 candidates for Member, 5 for Senior Member, 2 for Associate Member, and 1 for Honorary Member, upon whom agreement has not yet been reached. It is hoped that action on these can be completed in the near future.

There are also on hand the names of some 70 candidates for various grades, chiefly Membership, which will shortly be published for the information of all Senior Members and Fellows. Hereafter it is planned to publish lists of candidates and to hold elections twice a year, so timed that the date of election may be made effective either January 1 or July 1. The next list after the one now in preparation will be published during the summer and members are urged to submit for this list the names of those not yet elected to the Society who should be members of it.

It is the feeling of the Council that all foresters in forest work should be included in the Society in the appropriate grade. The cooperation of the membership in general and of the Sections in particular is asked to make this possible. In this connection, those en-

dorsing candidates for membership are urged to save time and labor by including the essential information necessary for action by the Council as indicated in paragraph 11 above. Forms following this outline on which nominations can be submitted are now in preparation. A supply of these will be sent to each Section as soon as they are ready, and additional copies can be secured at any time by addressing the undersigned.

S. T. DANA,
Member of Executive Council in Charge of Admissions.

REPORT OF THE EDITORIAL BOARD

The scientific journals of the country published by technical societies like our own have suffered greatly because of the increased cost of printing and somewhat disrupted membership as a result of the war. A number of the journals have greatly curtailed their publication, eliminated illustrative material, and whatever illustrations have appeared were, in many cases, paid for by the contributors themselves. The JOURNAL did not escape somewhat the general effects of the present time but on the whole I believe has fared better than many other scientific publications. In spite of the increased cost of printing and paper, in spite of the Society's scattered membership, and in spite of the national forest policy discussion, it is coming out at the end of this year, possibly a little thinner and with fewer plates and diagrams, in a fairly good financial condition and back to its old standard of a journal primarily devoted to technical forest problems.

The high cost of printing, of course, necessitated a more careful selection of the material which, after all, was not without good effect upon the JOURNAL's standard. The JOURNAL was handicapped during the last half of the year by the resolution adopted at the last annual meeting to devote five issues to the discussion of a national forest policy. For fear that the JOURNAL may be accused of partiality, it interpreted the resolution as publishing anything on the topic submitted to it which was not always of the usual quality of the JOURNAL. This is a good occasion to emphasize the need of keeping the JOURNAL a rather free publication without obligating it to give definite time or space to one particular subject. We must always keep in mind that out of an edition of 1,200, and of nearly 1,100 copies regularly distributed, only about 430 go to regular members of the Society. Six hundred and forty-five copies go to subscribers who are interested in the JOUR-

NAL OF FORESTRY as a technical organ devoted to the entire field of forestry. In this connection it may be interesting to mention how the JOURNAL is being distributed.

DISTRIBUTION, 1920

To members			431
To subscribers (including complimentary copies):			
United States—			
State forest offices	14		
Government forest offices	164		
Foresters (not members)	44		
Forest students	15		
Public libraries	23		
Colleges	64		
Scientific institutions	14		
Commercial organizations	21		
Lumber journals	6		
Miscellaneous individuals	61		
		426	
Canada—			
Government officials	33		
Foresters	77		
Libraries	3		
Colleges	3		
Commercial organizations	4		
Miscellaneous	7		
		127	
Europe—			
Great Britain	11		
Sweden	7		
Norway	2		
Denmark	2		
Finland	1		
Switzerland	2		
France	2		
Italy	1		
		28	
Asia—			
China	6		
India	9		
Japan	26		
		41	
Africa		15	
Australia		8	
New Zealand		4	
East Indies		4	
South America		1	
Total subscribers			654
Number JOURNALS sent out			1,085

The 1920 JOURNAL has 858 pages. The sizes of earlier volumes are as follows: 1919, 1,015 pages; 1918, 955 pages; 1917, 1,100 pages.

A rough classification of the contents of the 1920 volumes is as follows:

	Pages
Notes and Society affairs	52
Botany and zoology	31
Forest geography and description	40
Mensuration, finance and management	193
Politics, education and legislation	201
Silviculture, protection and extension	123
Soil, water and climate	31
Statistics and history	42
Utilization, market and technology	80
Miscellaneous	65
Total	858

Of the 94 articles in the 1920 JOURNAL, 35 were by Service men.

If the members were charged with the same subscription price as other regular subscribers, namely, $4, the JOURNAL would come within $79 of being self-supporting.

Mr. Ballard continued during the year to give his competent and valuable services in getting out the JOURNAL—services for which he receives a fraction of what they are actually worth to the Society. It is largely due to his promptness and insistence in dealing with the printer that the JOURNAL now appears without serious delays.

For the Board of Editors:

RAPHAEL ZON,
Managing Editor.

RESOLUTIONS ADOPTED AT THE ANNUAL MEETING

1—FERNOW'S WORK APPRECIATED

Whereas, The Society of American Foresters desires to express its affection for Dr. B. E. Fernow as a man and its appreciation of his services as the dean of forestry in North America; be it

Resolved, That the following telegram be sent to him:

"The Society of American Foresters at its annual meeting sends greetings to you as our oldest and most distinguished member. We regret that you are not with us today. We take this occasion to express to you what is in the mind of every member, the high esteem and appreciation of the great work that you have done and are still doing on behalf of forestry. We hope that you will continue for many years to come to be the inspiration and leading spirit as you have been in the past for the profession of forestry in America."

In reply, Dr. Fernow wrote the Secretary as follows:

"In returning grateful thanks for the kind words and thoughts of the Society meeting at New York, I realize that I am a happy man in having friends who do not wait till I am dead to say nice things about me. I have been unusually lucky, too, in living to see the results of my work. I have been a plowman who hardly expected to see the crop greening, yet fate has been good to me in letting me catch at least a glimpse of the ripening harvest.

"We are standing at the beginning of a new era, largely brought about by the good work of the members of the Society. When a national forest policy is being discussed in commercial bodies like the Paper and Pulp and Lumbermen's Associations, we may well hope for a realization of our aims.

"Trusting that I may still be of use in the ranks.

"Sincerely yours,.

"B. E. Fernow."

2—PROMOTION OF FOREST EDUCATION

Whereas, The following resolution was passed by the Second National Conference on Education in Forestry:

"Resolved, That this conference recommends to the Society of American Foresters:

"1. That it appoint, through its President, a Committee on Forest Education to consider all suggestions made to this conference, whether in formal reports or otherwise, together with such other phases of forest education as it deems advisable.

"2. That this committee consist of (*a*) the chairman of this conference as chairman; (*b*) the chairman of the eight committees reporting to this conference in those cases where these chairmen are Senior Members of the Society, and in cases where they are not, of some other member of the committee who is a Senior Member of the Society; and (*c*) three other members.

"3. That this committee be authorized to appoint sub-committees which may include persons to be appointed by the chairmen who are not and do not by virtue of such appointment become members of the main committee.

"4. That it report the results of its investigations with recommendations to the Society from time to time"; be it

Resolved, That the President be and he is hereby instructed to appoint a Committee on Forest Education along the lines and for the purposes suggested by the Educational Conference.

3—CLASSIFICATION OF SITES

Whereas, A uniform system of site classification applicable to the whole country would, if practicable, greatly simplify and facilitate forestry work; and

Whereas, Several plans for site classification have recently been suggested, and

Whereas, The Society of American Foresters is the logical agency through which an agreement of the profession as a whole as to the principle and detail of a general plan of site standardization may be secured; be it

Resolved, That a committee be appointed to consider the various suggestions for site standardization, with reference to their practicability for adoption by the profession; to secure, in its discretion, an expression of opinion of the Society as a whole upon the plan or plans favored by the committee; and to report its recommendations to the Society for action not later than the next annual meeting of the Society.

4—CORRELATION OF THE ACTIVITIES OF THE SEVERAL SECTIONS

Whereas, It is highly desirable to correlate more effectively the activities of the several sections of the Society and to promote particular lines of work in which two or more sections are especially interested; be it

Resolved, That the chairman of the several sections *ex officio* be created an Intersection Committee of the Society to co-ordinate and further the work of the sections of the Society as a whole; and be it further

Resolved, That the President of the Society name from among the section chairmen the chairman of this committee.

5—FOREST RESEARCH ENDORSED

Whereas, Any comprehensive national forest policy must be based on thorough-going research; be it

Resolved, That the Society of American Foresters urge the liberal support by Congress of such research through Federal appropriations for investigation in forest fire protection, forest reproduction, forest management, forest taxation, wood utilization, and similar fields.

6—A NATIONAL ARBORETUM RECOMMENDED

Whereas, There exists at present no National Arboretum and the present so-called Botanic Garden at Washington is totally inadequate for the purpose and is seen by an insignificant number of visitors or residents, and

Whereas, There is a real need for an adequate arboretum and botanic garden in the vicinity of the National Capital which would afford a broad field for scientific education and the enjoyment of plant and animal life, and

Whereas, The Government already owns some 400 acres along the Anacostia River admirably adapted for the establishment of a water garden and bird refuge, and

Whereas, Adjacent to these lands are some 400 acres of uplands of diversified soil and varied exposure, including the prominent landscape feature of Mt. Hamilton and containing not less than 36 different species of native forest trees and containing also tracts of level, fertile soil, excellent sites for greenhouses, propagating gardens, and experimental uses; be it

Resolved by the Society of American Foresters, That Congress be and is hereby requested to approve the proposed plans for the development of the Anacostia River tract and the acquisition of the Mt. Hamilton and other adjacent lands for development and use as a great national herbarium and botanic garden.

7—COMMERCIALIZATION OF NATIONAL PARKS CONDEMNED

Whereas, There is a powerful movement to seize the waters of the National Parks for industrial uses, and

Whereas, This movement, if successful, would create a precedent that would jeopardize the primary object for which the National Parks were created; be it

Resolved, That the Society of American Foresters endorses the principle that industrial use of the National Parks should not be permitted and that Federal forest lands on which commercial development is desirable should be included in National Forests; and be it further

Resolved, That the Society specifically opposes the principle embodied in the bill at present before Congress (H. R. 12466) to give part of the Yellowstone National Park to certain irrigation interests,

and favors excepting the National Parks from the provisions of the Water Power Act.

8—CONSERVATION OF WILD LIFE URGED

Whereas, Wild life is an integral part of the resources of the forests, and persons interested in fish, game, and other wild life form a large and influential part of the public who can be depended upon to support forestry measures; be it

Resolved, That the Society of American Foresters favors the study and conservation of wild life as well as of other natural resources.

9—INCREASE IN CIRCULATION OF THE JOURNAL RECOMMENDED

Suggestion was made by the Committee indicating the desirability of co-operation on the part of individual members of the Society in securing additional subscriptions to the JOURNAL OF FORESTRY as a means of helping to make it self-supporting. This subject was discussed but no action taken.

10—FUTURE MEETINGS OF THE SOCIETY

"That in arranging for future programs before the annual meetings of the Society of American Foresters the responsible officers or committees shall be guided by the following suggestions:

"(*a*) Only subjects of maximum current urgency and interest to be considered as available.

"(*b*) Subjects to be of such character only as to lend themselves to verbal presentation and the consideration of the audience.

"(*c*) All papers to be submitted by their authors for the O. K. of the responsible officers or committee, prior to the meetings.

"The intent of this resolution is to insure the greatest practicable interest in and profit from the annual programs, ample chance for discussion, etc."

11—FOREST SCHOLARSHIPS IN EUROPEAN SCHOOLS URGED

The following resolution adopted at a meeting of the Denver Section of the Society of American Foresters, December 6, 1920, and presented to the annual meeting by Mr. A. F. Fischer, was read with the explanation that while the Committee on Resolutions sympathized with the object aimed at it had not had time to re-draft the statement in resolution form for action by the meeting:

In order to further the interchange of ideas and strive toward a broader view of forestry problems and their solution, and to promote the spirit of international good fellowship and mutual understanding among foresters, it is the sense of the Denver Section that the Society of American Foresters should declare itself in favor of the attendance of American students of forestry at Forest Schools of acknowledged standing in other countries, notably the French Forest School at Nancy.

That the Society should seek the endowment of scholarships for the purpose of encouraging and making possible such attendance, and should offer its good offices for the arranging or placing of such scholarships and the selection of suitable candidates.

That the recipients of such scholarships should be men of good personality as well as scholastic attainments, who have given evidence of interest in the practice of the profession of forestry which promises to be permanent, who shall preferably have completed at least one year of study of forestry subjects in an American forest school of recognized standing, and who shall be able to at least read comprehendingly the language of the country in which they propose to study.

It is the opinion of the Denver Section that one or two scholarships of the French Forest School at Nancy are particularly desirable.

By a vote of the meeting these suggestions from the Denver Section were referred for action to the Committee on Education.

12—PUBLIC CONTROL OF PRIVATE TIMBERLANDS ENDORSED

The following resolution was adopted by a vote of 28 ayes to 15 noes:

"Believing that the public welfare in this and in succeeding generations requires that the United States be self-sustaining and independent of all foreign sources of timber supply, and that our forest lands should therefore furnish in perpetuity ample supplies of timber and other forest products to meet the needs of our people and our industries, and believing that such continuous productions can be guaranteed only by some degree of public control of the use of our forest resources the Society of American Foresters, regardless of the opinion held by individual members as to whether the Nation, States, or other competent public agencies should exercise this control, desires to go on record as unequivocally favoring the principle of public regulation of the use of forest lands."

13—ANOTHER VOTE OF STATE VS. FEDERAL CONTROL TO BE TAKEN

Whereas, There exists in the minds of many members of the Society a lack of clear understanding as to the exact sentiment of the Society on the question of National versus State control; be it

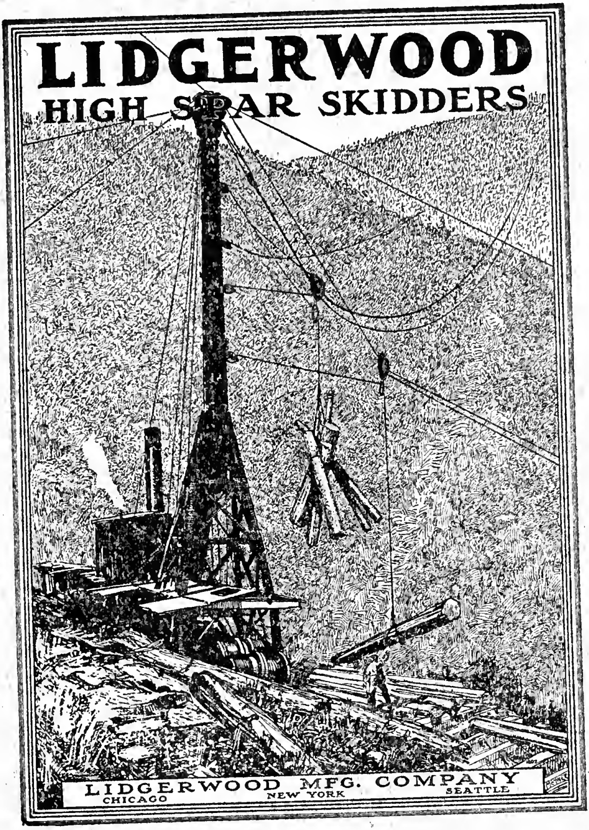
Resolved, That a letter ballot worded as follows be submitted to the entire membership:

"Do you favor national control as exemplified in the proposed revision of bill S. 4424 or State control as exemplified by bill H.R. 15327, copies of which are herewith enclosed"; and be it further

Resolved, That the Secretary of the Society be instructed to secure such an expression of opinion by letter ballot before March 15, 1921.

14—STANDARDIZATION OF FOREST FIRE PROTECTION MEASURES

Motion was made and adopted that the President appoint a committee to study the question of accomplishing a standardization of forest fire protection measures and equipment.



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JOURNAL OF FORESTRY

VOL. XIX MARCH, 1921 NO. 3

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

STATE OR FEDERAL CONTROL OF PRIVATE TIMBERLANDS

RESULT OF THE BALLOT

At the annual meeting in New York, on December 20, 1920, a resolution was adopted providing for a ballot by the members of the Society of American Foresters to express their preferences between Federal control of privately owned timberlands, as exemplified by the proposed revised Capper bill, and control by the individual States, as exemplified by the Snell bill.

The vote, which closed on March 15, resulted as follows:

	Federal control	State control	Number voting
Fellows	3	1	4
Senior Members	75	141	216
Members	24	33	57
Associate Members	7	20	27
	109	195	304

PAUL D. KELLETER, *Secretary*.

WILLIAM N. SPARHAWK,
WILLIAM D. STERRETT,
Tellers.

FORESTRY IN RELATION TO LAND ECONOMICS

By W. D. Sterrett,[1]

Forest Examiner, U. S. Forest Service

Introduction

It is desired to emphasize in this paper the subject of classification of land resources from the standpoint of its economic utilization as furnishing a good point of view from which to further the development of forestry by public forest agencies. As the primary requirement for the growing of forests is land, the first step, theoretically, toward securing the practice of forestry on any land would seem to be its classification as economically best suited for timber growing. In order to make such a classification most effective, it should be in agreement with the owner's judgment, after an intelligent review of the facts for himself. The owner would then be satisfied to put the land to work growing forest, and enter into forestry work with sincerity and earnestness of purpose. Would not this method of securing forestry on private lands possibly be more rational and practicable than to attempt to secure compulsory forestry on privately owned timberlands? Land classification with special reference to lands for timber growing, including land for public as well as private forests, seems to me to form an important line of work for public agencies charged with the development of forestry.

Many of our foresters agree with the thesis of the agriculturist that it is gross misuse of the land to grow forests on possible agricultural land. The error of this point of view will be shown later. A State forester, with whom the subject of land classification was discussed, who had given the matter considerable thought, expressed the opinion that such work would be detrimental to forestry development. He said that owners of rough mountain land in a certain section of his State were claiming it all to be the finest kind of land for fruit growing, and it would be disastrous to the cause of forestry for him to attempt to classify any of it as land economically best fitted for timber growing,

[1] Including comments by Dr. L. C. Gray.

even though under the most favorable possibilities only one per cent of it would be developed as fruit land in the next 100 years. Such objections to land classification can be readily overcome by showing that forest forms the most economic and profitable immediate use for certain land, and this work should be made a leading tool for public agencies to use in the development of forestry along stable lines.

Expenditure of money for fire protection, the most important present work of forest agencies as a whole, can hardly be justified for cut-over lands unless they have been definitely classified as land economically best fitted for growing forest, at least for the next generation or rotation. It may be argued, however, from a broader point of view, that fire protection is essential on all cut-over lands to preserve the fertility of the soil for any future use that is to be made of the land, whether for timber or agriculture.

SOME CRITICISMS OF PRESENT FOREST POLICIES

Present forest policies seem inadequate from the standpoint of land classification with reference to economic land utilization, which, it is believed, furnishes the most fundamental basis for promoting forestry. In Colonel Graves' circular on "A Policy of Forestry for the Nation," land classification is mentioned among responsibilities the public should assume, but its importance and significance warrant still stronger emphasis than it receives there. In the Capper report on timber depletion, land classification work may, perhaps, be indicated in the chapter on "Federal Legislation Needed" under caption No. 5 on "Survey and Classification of Forest Resources." The report, however, does not specifically recognize land classification as an important working basis for the promotion of forestry.

Instead of a survey of forest resources or timber census, the writer believes it more important to have a broad and detailed survey of all lands in the country for purposes of land classification, to determine especially land to be recommended as economically best suited for growing of forests, public and private, at least for the next generation.

Some foresters stress the importance of working out the total area of land needed to produce an abstractly figured demand for forest products, on the basis of a per capita consumption of forest products of over 10 to 1, as compared with France and England, for the purpose of getting public backing for a program of compulsory forestry on private timberlands. The major premise or primary basis for advo-

cating compulsory forestry on privately owned forests, by either Federal or State control, lies in the assumption that forest products are "an absolute necessity of life," and that a shortage in such products would be a dire calamity. An important question, and one which perhaps has not been sufficiently canvassed, is to what extent the engineering profession would accept this thesis of the foresters as to the "absolute necessity" of forest products; also of value in this connection would be the ideas of the engineers concerning ways of making forest products go much further, if need be, by different methods, such as preservative treatment, fire-proofing, careful utilization, etc.[2] It is said, for instance, that black paper with white ink (much better for the eyes) would make it possible to use any kind of wood for newsprint, and that the same paper could be used over again many times.

A forester in one of the leading railroad systems of the country once made the statement that the engineers in his organization had the best of the argument on the negative side of the question of the necessity for forest products for construction purposes and, in fact, for any purpose whatsoever, as they could always supply a good substitute for, or an improvement on wood. These practical engineers admitted, however, the value of forests for wild game and sporting purposes. While this is an exaggerated point of view, there is considerable truth in it. There is also considerable truth and common sense in the statement that: The sooner we get complete devastation of forests, or an approach to it, the quicker we will get real sincere forestry by private as well as public owners, and forestry will come to stay because it will become profitable to grow timber. This so-called devastation means, in practical language, merely the removal of the large supplies of stored up virgin timber. As a matter of fact, the desolation dreaded by some foresters will never take place, due to the bounteous provisions of nature, aided by man's practical fire protective measures.

It is interesting to note what England is doing in the way of forestry. This is a country provided most inadequately with forests, and the most dependent on other countries for forest products, of any in

[2] Howard F. Weiss, the forest products engineer, in the JOURNAL OF FORESTRY for October proposes to secure forest management by creating such a demand for the products of the forest that the price received for them will more than equal the cost of growing and producing them. In other words, an important cause of forest devastation is the poor possibility for intensive utilization of forest crops, which obtains especially in forested regions remote from markets.

Europe, having only one-tenth acre of forest per capita, and this with a devasted growing stock, as compared with one-half acre of much better forest in France and Germany, and 5 acres per capita in this country. The war brought home to England very strikingly the need for home forests containing reserves of forest products for war needs, and a forestry reconstruction subcommittee was appointed before the war closed to investigate forestry conditions and to make recommendations. This committee [3] recognized the inviolability of private forest property, and did not recommend mandatory laws governing the control and regulation of such property, but recommended co-operation and financial assistance from the public to private owners in the growing of timber. The forestry act, which came into effect in September, 1919, follows very closely the recommendations of this forestry committee. The primary feature is a commission of eight members with wide powers for "promoting afforestation and the production and supply of timber," including purchase or lease of any land suitable for afforestation, purchase and sale of standing timber, advances of loans for private afforestation, management and supervision of woods, establishment and aiding of woodland industries, collection of forest statistics, promotion of forestry education, experiment and research, and making inquiries for securing an adequate supply of timber in the United Kingdom and in the Dominions.

If public needs demand the growing of forests on certain areas in this country for streamflow and water regulation purposes, or even for securing admittedly desirable advantages of reserves of timber products for temporary construction work in war times, the proper course would seem to be to purchase or lease such areas, as outlined in the forestry program recently adopted by England. The growing of forests as a public utility is one, par excellence, for Government ownership, as it is one in which private individuals and corporations have very little interest, and one which the Government can acquire without serious conflict with private owners and capital. Land classification as a basis for economic land utilization is of great importance both, as a basis for acquiring and holding land for public forests, and for promoting forestry on private lands.

[3] See JOURNAL OF FORESTRY, May, 1920, pp. 569-71.

ECONOMIC CLASSIFICATION OF LANDS BY THE DEPARTMENT OF AGRICULTURE—OFFICE OF FARM MANAGEMENT

Economic classification of land resources by the Department of Agriculture came prominently to the front in the spring of 1919 when it was considered in conferences held to re-organize the work of the Office of Farm Management, and a Division of Land Economics, under Dr. L. C. Gray, was formed and charged with this work. All Bureaus of the Department were invited to be represented at the conferences. The following is a resumé of the findings of the committee on land classification, appointed by the conference:

Economic classification of lands is constantly shifting, due to changes in prices and demands for products, market facilities, costs of production, and size of farms, and population and demands of the local community. These factors being equal, an economic classification at a given time and in a given locality would be based on a number of schemes of land classification, including:

1. Physical and biological classification.
   (*a*) By soils.
   (*b*) By vegetation (cultivated or wild plants, or both).
2. Classification by use, actual or potential.
   (*a*) Farm lands.
   (*b*) Forest lands.
   (*c*) Grazing lands.
3. Classification in relation to moisture.
   (*a*) Swamp lands.
   (*b*) Arid lands.
      Irrigable.
      Nonirrigable.
   (*c*) Intermediate lands; that is, well drained or easily drained and with a natural, dependable moisture supply.

Considering the comprehensiveness of the data required it was decided that a large number of agencies should be interested in the task of land classification, including the following:

Department of Agriculture:
- Bureau of Plant Industry.
- Bureau of Soils.
- Bureau of Crop Estimates.
- Bureau of Animal Industry.
- Office of Farm Management.
- Forest Service.
- States Relations Service.

Department of Agriculture—Cont'd.
Weather Bureau.
Biological Survey.
General Land Office.
Geological Survey.
Reclamation Service.
Bureau of the Census.
State Experiment Stations and other State institutions.

The conclusions of the Committee read as follows:

"Your committee considers the need of an agricultural classification of land resources of the country from the standpoint of its economic utilization as imperative. The resulting information when supplemented by such field surveys as may be necessary would be of immediately practical value in many ways, such as guiding the course of land settlement; determining the economically efficient size of farms in different localities; and in giving wise direction to the agricultural energies of the country in the production of food and raw material.

"This classification can be based, in part, on information which has been gathered by various bureaus of this and other Departments, as well as by State and private agencies. These data have, however, never been assembled, correlated and appraised from the standpoint of economic utilization of land."

CONSIDERATIONS FAVORING CLASSIFICATION OF LAND FOR FOREST PURPOSES

The primary duty of any public forestry agency, with reference to classification of any particular tract of land from an economic standpoint, would obviously seem to be to make as clear and strong a brief for forest occupation of part or all of the land in question as is possible by showing what can be expected from timber growing and all the advantages of having the particular piece of land in forest, regardless of whether the land is agricultural, possible agricultural, or non-agricultural. The agricultural and other points of view are amply taken care of by other agencies. The forestry point of view will naturally carry the greatest weight as applied to non-agricultural land, but this does not lessen the importance of showing the advantage of having forests on agricultural and possible agricultural land. In many cases foresters show a tendency to accept too readily the thesis of the agriculturalist as to the comparative unimportance of forests as a form of land utilization as compared to agricultural crops, which leads to an exaggerated notion of the importance of growing the latter on all possible agricultural land. This agricultural viewpoint might well apply to

certain restricted areas of dense population in Europe, but does not suit the United States with its present population, nor is it likely to do so for a number of generations to come. It behooves foresters all along the line to cultivate a stronger grasp of the values and advantages of forests as a form of land utilization, and to be less deferential to the agriculturist on this score.

The considerations favoring the classification of a given tract of land, or parcel of it, for forest purposes can be conveniently grouped under three heads:

I. General advantages of forest over agricultural crops as a form of land utilization.
II. Indirect utility of forests.
III. Profits to be expected from growing of timber.

I.

General advantages of forest over agricultural crops as a form of land utilization include:

(*a*) Forests form Nature's climax form of land utilization over the largest part of the country, and forest crops can be grown continuously by natural reproduction with the least possible effort and expense.

(*b*) Forests yield the widest and most varied range of useful products of any kind of crop which can be grown. While production of almost any agricultural crops can readily be overdone, especially locally, this is hardly conceivable for forest production because of the great variety of products or forms in which this crop can be harvested.

(*c*) Forest crops can be harvested when it best suits the convenience of the owner or the demands of the market, to a much greater extent than can agricultural crops, and form a more readily salable crop, in its great variety of products, in the world market than do agricultural crops as a whole.

(*d*) There is too much improved land in the United States for domestic demands, nearly 5 acres per capita as against two-thirds rods in northwestern Europe which has about the same average natural fertility of soil and no better average climatic conditions. In the State of Virginia there were 800,000 less acres of land in crops in 1915 than in 1908, yet the production in 1915 was much greater, due to improved methods of agriculture.[4] Too much improved land is the cause of so much idle cleared land in the United States. The present improved

[4] From report of the State Commission of Agriculture and Immigration.

area could be made to support a gradually increasing population to five times the present by gradually increasing the intensiveness of cultivation. Forests form the most economic use for wide areas of land not needed for agriculture or grazing.

(*e*) The area of improved land could be considerably reduced if it were desirable to have it more nearly coincide with the economic requirements of the country for agricultural crops (allowing a certain per cent for export) produced under reasonably good agricultural methods. This would lessen the possibility of the agricultural industry suffering from overproduction, which is so easily brought about for any particular crop, whether locally or generally, and is the bane of the farming industry.

Professor Ely,[5] the economist, is reported to have said that the land situation is *not* that too great an area of *good land is not* now used for agriculture, but that too great an area of *poor land is* so used. There is too much counterfeit farm land in circulation, which is not needed and should not be used for agricultural crops.

II.

Considerations of indirect utility of forests include:

(*a*) *Climate,* including effects of forests in leveling extremes of temperature of the air and soil, effects on the moisture or humidity of the air, on the movement of water in nature, and on rainfall.

(*b*) *Soils,* in increasing their fertility, including the renewal of worn-out land.

(*c*) *Streamflow and erosion,* including the retarding effects on run-off of storm water and improved conditions for storage of water.

(*d*) Water supply, health, esthetic and recreational uses of forests, for which reasons alone a farm with a well located grove of trees often has a higher sale value than one without.

(*e*) Military tactics and strategy.

(*f*) For convenience of home use—fuel, posts, and other uses.

(*g*) As a windbreak for buildings and crops.

(*h*) As furnishing work for man and teams at slack times of the year.

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[5] Professor Ely is Director of the newly formed Institute for Research in Land Economics. Membership in this institute is especially desirable for and open to all interested in land utilization problems.

(*i*) As a temporary crop on intrinsically good agricultural land, which it is desired to hold for future clearing and development, it being more advisable to first work up intensive agriculture on areas already cleared.

III.

Profits to be expected from growing of timber, based upon possible yields of stands of different species under management on different qualities of site and upon possible future stumpage values for forest products, are the most important practical determining consideration to be used in land classification work. Unfortunately, at present foresters are very inadequately prepared to answer questions relating to possible yields of well-stocked stands of different species under management on different qualities of site or physical types of land. The collection and computation of figures dealing with the growth of stands, a primary practical problem that should engage the attention of foresters, has been very much neglected. From the standpoint of economic land utilization studies a large amount of work is needed on investigation of yields of well-stocked stands of different ages, species and types, which indicate the productive capacity of land under forest management. The resultant yield tables should be tied up to site classes based on height of a given species or type, at a given age, as height is the most practical index to use in judging differences in yield capacity of different land for different species and types.

CONCLUSIONS AND SUGGESTIONS

1. All public forestry agencies should enter the field of land classification as a basis for classifying land economically best fitted for growing of forest.

2. A program of forestry for the nation should concentrate very largely on land classification with reference to what lands should be used for forests.

3. Such a program should be along two general lines:

(*a*) Determination and mapping of broad areas throughout the Nation which obviously should be in permanent public forests (Federal or State) for general economic reasons of public welfare. For this work Federal and State forestry organizations should assume entire responsibility.

(*b*) Local or county land utilization plans, based on detailed land classification work and economic factors, in which work Federal and State forestry agencies should co-operate with agricultural and other agencies, especially various local agencies and individuals. To make any scheme of economic land utilization of practical use in a given community it must gain the intelligent approval of the community. The object is to bring scientific economic land utilization plans, including the use of land for forest, down to the people.

4. Work along the first of the above two lines, that of public forests, is already under way and will not be discussed here. The following are suggested as some of the important features to be included in work on local or county land utilization plans by Federal or State agencies, bearing on the classification of lands for forests:

(*a*) Collection and use of all available soil and physiographic maps.

(*b*) Present land utilization map.

(*c*) Mapping of extensive areas of absolute forest land, and of land of the less valuable agricultural types (actual or potential).

(*b*) Determination of the amount of good agricultural land not needed for agriculture because of lack of population and danger of overproduction of agricultural crops.

(*e*) Classification of relatively large areas, if any, which should be in public forests because of general economic considerations.

(*f*) Analysis of the economic possibilities in timber growing on different classes of land based on yield tables for different qualities of site.

(*g*) Analysis of needs for forests and recommendations regarding their location for a County as a whole and for the individual land owners: (1) For supplying demands of local market or home needs; (2) for water supply protection, and erosion and streamflow regulation; (3) for protection of crops and buildings from winds, etc.; (4) for recreational and esthetic purposes, including the question of recommending areas for county and State forest parks; (5) as the best crop to grow on areas not needed for agriculture.

It is easy to see how such local land utilization plans would be useful in promoting forestry locally and in securing local sentiment for State and National forestry legislation, but not along compulsory private forestry lines.

If foresters fail to aggressively enter this field of land classification, it is likely that the development of this subject will become distorted

toward uses of land for agricultural crops, resulting in increasing the area of poorly cultivated and idle cleared land.

Comments by Dr. L. C. Gray

Note.—The following comments on the foregoing paper were made by Dr. L. C. Gray, Economist in Charge of Land Economics, U. S. Department of Agriculture. The author did not change his paper on the basis of these criticisms, some of which he concedes to be, to a large extent, valid. The primary purpose of his article is to arouse interest and provoke discussion, which accounts for the emphasis placed on certain points.

The central theme of this paper is the necessity of land classification as a means of scientifically selecting lands that shall be devoted to forest uses—whether by public or private agencies. A careful reading of the paper, however, indicates that it involves an argument that official forestry agencies shall use the modus operandi land classification for the purpose of aggressively promoting the expansion of the relative position of forest industry in the industrial life of the Nation. The forest is no longer to be the residual claimant for the use of the land (the conventional position usually assigned to it under the theory of highest use), but is to encroach not only on the twilight zone of uncertainty of economic use, which lies between agriculture and forestry, but also is to invade the present area of "improved land."

As a basis for such an aggressive point of view with reference to the claims of forests the author attempts to give the reasons for the relative importance of forests as compared with agricultural uses. The reasons are summarized on pages 230 and 231. The detailed reasons are grouped under three main headings. I would not undertake to criticize the points made under the second group. The arguments advanced are largely technological, involving necessity for stream regulation, improvement of soil fertility, and similar points which are well recognized as furnishing grounds for the policy of public forest reserves. However, the points grouped under 1 and 3 are worth a careful scrutiny. Some of them will not bear critical examination. For instance, (*a*) under 1 involves the somewhat sentimental statement that "Forests form Nature's climax form of land utilization," and that "forest crops can be grown continuously by natural reproduction with the least possible effort and expense." I am wondering what comparison is implied in the term "least possible effort and expense." It may be presumed that "least" means the comparison with other kinds of

uses, but does this "least expense" mean "least expense per acre," which would be meaningless because there is no economic reason why we should produce those crops which involve the least expense per acre irrespective of relationship between expense and value, or does the author mean "least expense per physical unit of production," or does he mean "least expense per unit of value of production." If the latter is meant, and this would be the only meaning that would have real economic significance, one is inclined to wonder why there has not been a more widespread tendency on the part of private enterprise to take advantage of the superior profitableness implied by the statement, assuming, of course, that due allowance has been made for ascertaining the present value of prospective future profits.

In (*b*) of the same group the point is made that over-production for forests is hardly conceivable because of the great variety of products, while the production of almost any agricultural crop can readily be overdone. Now it is not only possible that forest production could be overdone absolutely, but it is exceedingly probable that it could be overdone relatively, and this is the essential point. In other words, if forest production encroaches too much upon agricultural land it has been relatively overdone. Moreover, while it is true that physically we do not have to cut the timber until we need it, economically the rate of interest and taxes assert a tremendous pressure to realize returns as soon as possible from any expenditure in forest development on the part of private persons. Consequently, if the argument is intended to apply to the extension of forest areas by private individuals it is clearly possible that the area might be very much overdone because of the fact that the product could not be profitably marketed rapidly enough to overcome the losses from deferment of return and expenditure for taxation.

There is possibility that there is some truth in the statement that there is too much improved land in the United States for domestic demands, but certainly the statement is not proven by the assertion that the amount is 5 acres per capita as against two-thirds of an acre in Northwestern Europe. Northwestern Europe is notoriously a crowded country in which the very scarcity of land in proportion to labor has caused the average return per unit of labor to be very much lower than it is in the United States with a resulting reduction in relative standard of living. There can be no question but that we can make a more scientific and effective use of our improved acreage. But

it is a serious question whether the Nation either by public or private agencies should engage in heavy expenditures to put land into forests unless there is prospective grounds for believing that the present value of the expected return will yield a reasonable margin of profit over the necessary expenditure. In fact, the confession in the paper that foresters are "very inadequately prepared to answer questions relating to possible yields of well-stocked stands of different species under management on different qualities of site or physical types of land" would seem to be ground for caution in undertaking a program of unduly rapid expansion of forest area by afforestation.

In conclusion I would say that the paper is a suggestive and interesting one and that I do not offer the present criticism by way of objecting seriously to the idea that a systematic policy is not desirable and that it should be based on a reasonably scientific process of land classification, but merely because I believe that some of the points in the paper reflect an extreme point of view which should be given more careful consideration in their economic aspects before being publicly advocated.

THE MORPHOLOGY OF WOOD IN RELATION TO BRASHNESS

(Contribution from the Department of Wood Technology, New York State College of Forestry, Syracuse University)

By C. C. Forsaith

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Before the era of steam and other mechanical engines, the question of defects in wood was not seriously considered both on account of an abundant supply from which only the best need be selected and also because the strains to which is was subjected in horse-drawn vehicles were relatively slight in comparison with those encountered in modern practice. Furthermore the size and weight of structural members in those days did not prohibit construction allowing a high factor of safety. The introduction of the gas engine into industry, however, changed this situation, and especially in connection with aircraft production, at once raised the problem of brashness and other imperfections to a plane of vital importance. Not only did the greater stresses produced by a powerful motor subject the assembled parts to exceptional strains, but also the need for lightness made necessary a reduction in size and a corresponding lessening of the factor of safety out of all proportion to that formerly considered to be a minimum. Such a development made it essential to employ only those timbers which were free from defects.

Wood is heir to many imperfections, but none is more subtle or more treacherous in its liability to failure than brashness, and since this paper deals particularly with the underlying causes for such a defect a few words of definition will not be out of place.

Brashness, a synonym for brittleness, is that property inherent in wood which causes timber under strain to break suddenly, with a sharp report, and to leave on rupture smooth, unsplintered surfaces. A fracture of this type is shown in figure 9 which represents the broken ends of a stick of brash tulip poplar, *Liriodendron tulipifera*. A non-

brittle wood on the contrary sustains a much greater load without breaking, and will upon failure, give more slowly, with a prolonged cracking sound and exhibit a lacerated splintered appearance as illustrated in figure 12 which pictures the broken end of a strong specimen of the same species. Some woods like California redwood are habitually brash, while such a quality is exceptionally rare in hickory or white oak. Other trees show variation in this respect since some timbers are brash and others strong.

The process used in testing wood for brashness presents only a simple problem in physics which may be found fully explained in any text on the mechanical properties of timber, but as this phase of the problem is really outside the province of this paper a few brief remarks will serve to clarify the connection as between weakness and anatomical structures. Whenever a strong timber is tested either by impact, static bending, or compression, deformation is proportional to the stress applied up to a definite point known as the fiber stress at the elastic limit. Beyond this, as recorded on the stress-strain diagram, deformation progresses at a faster rate until rupture takes place as that point determined upon as the modulus of rupture. A brash wood tested under such conditions shows a proportionally low opposition to flexure or pressure, and the interval between the fiber stress at the elastic limit and the modulus of rupture is small, and the failure abrupt.

Unlike many structural materials, wood is a product of growth, and not one fashioned by man for his own uses. In common with all living organisms it consists of cells which have become modified during the evolution of the arborescent type in ways which are suited to serve the functions necessary for existence and growth. This life process may for convenience be divided into three main classes in so far as it has a bearing upon the stelar anatomy. The vertical elements which in the conifers consist of tracheids serve both for conduction and support. Scattered among the tracheids in the Pineous group are tubular passages lined with parenchyma which aid in the transportation and storage of resin. These canals are a source of weakness only as they diminish the strengthening tracheary content. The only other vertical elements in soft woods are the septate parenchymateous storage cells evolved during past geological ages to conserve the food supply during a resting season. They affect timber in much the same way as do resin canals only to a less extent. Interjected between the longitudinal cells there are radial plates of thin-walled storage tissue, the wood rays,

which for the plant serve a double purpose; one to act as a storehouse for carbohydrates, oils, and the like, and the other to act as conduction channels from the phloëm toward the center of the tree. These bands are mechanically important and will receive later consideration.

In the dicotyledons the division of labor has progressed beyond this more simple stage, and large specialized cells, known as vessels, have been developed for conduction. For strength and support, the more individual fibers have taken the place of the coniferous tracheids. The other structural features have close analogies in the soft woods and need not be mentioned. The vessels and fibers vitally affect the mechanics of timber and consequently bear a very intimate relation to brashness.

As these anatomical features are closely associated with brashness, careful measurements of the following type were made in order to clarify the affinity as between structure and weakness:

1. The specific gravity bases on oven-dry volume was determined in the usual way, by immersion. The purpose of such a test was to serve as a check upon anatomical variations as well as to ascertain the scientific grounds for its high regard among inspectors.

2. The number of rings per inch or per centimeter was learned by a direct count over as wide an area as the material at hand permitted.

3. The percentage of summerwood was calculated by micrometer measurements on prepared sections under low magnification.

4. The percentage of ray tissue was calculated by methods developed in this laboratory. The process by which these computations were made will appear in another publication.

5. The volumetric proportion of the fibrous tissues in the tulip poplar was ascertained in the same way.

6. The thickness of the fiber wall or tracheid wall represents an average of several careful measurements on many cells under high magnification. This test proved to be one of the most important made since it determined the amount of woody substance which of course is the ultimate proof of strength or weakness in wood.

7. The diameter of the vertical elements was also computed by measurements under high magnification and the technique by which this was done may be used to compute the number of fibers per unit volume after deductions for the ray and vessel content have been made.

8. The length of the fibers and tracheids was determined by measuring about sixty cells in each case.

9. The dimensions of the rays was determined by measurements on the tangential face of the wood.

10. The number of bordered pits represents an average count for several cells.

The three woods chosen for special consideration represent widely separated families. The bald cypress, *Taxodium distichum* (L.) Rich., from the Pinaceae, represents the coniferous type; the tulip poplar, *Liriodendron tulipifera* L., from the Magnoliaceæ, represents a diffuse porous dicotyledon; and the white ash, *Fraxinus americana* L., from the Oleaceæ, represents a ring-porous wood.

Turning to a consideration of the special examples, figure 1 shows a transverse section of the normal stemwood of *Taxodium distichum* magnified to 150 diameters. In the upper portion of the figure the thin-walled spring tracheids may be seen, while the lower portion is occupied by the thick-walled strengthening cells which were formed later during the growing season. In the section here represented the thick-walled tracheids occupy about 38 per cent of the area. The dark vertical line bisecting the right side of the print pictures a uniseriate storage ray cut longitudinally. Figure 2 shows a cross-section of a brash cypress under the same degree of magnification. It will be observed that the same types of cells are present. The only new features represented in the section are the storage parenchyma cells which, owing to their resinous content, have registered black on the photographic print. Such structures were present in the first section mentioned, but do not appear in the field selected for the illustration. The most striking difference between the two woods is in the volume of the summerwood. In contrast to 38 per cent in the first, only 2 per cent can be so classed in the second. The relative thickness of the tracheid walls is as equally indicative of the brash character of the latter as is brought out in Table 1 which includes comparative data of the two woods. In the second column is recorded the specific gravity for the two specimens, and it will be observed that the stronger stick is about twice as heavy as the weaker or brash one. The same proportion is maintained in regard to the thickness of the cell walls. Those in the summerwood average .009 mm. and .004 mm., respectively, and a like relation exists in the springwood where the measure is .004 mm. and .002 mm. In other words, the thick summer cells in the brash wood are only equal in thickness to the thin-walled spring tracheids in the stronger one. Reference has already been made to the

weakening effect of the storage rays, the volumetric data here shown indicate an almost complete inverse ratio to that of the thickness of the lignified walls and the specific gravity.

TABLE 1.—*Taxodium distichum* (*L.*) *Rich.* *Measurements in millimeters.*

Character of wood	S. P. G.	Per cent of summerwood	Per cent of rays	Thickness of the wall of summer tracheids	Thickness of the wall of spring tracheids	Length of summer tracheids	Length of spring tracheids	Tangential diameter of tracheids	Radial diameter of tracheids	Height of rays	Rings per cm.
Strong	.68	38	06	0.009	0.004	5.27	4.93	0.065	0.057—.041	0.25—0.05	6.5
Brash	.25	02	11	0.004	0.002	2.85	3.09	0.038	0.070—.032	0.54—0.06	8.7

Brashness has so many times been considered to be due to short tracheids or fibers that special attention was paid to this phase of the problem and the general results obtained hardly justify such an assumption. To be sure there is in the case of *Taxodium,* as mentioned in the table, an appreciable difference in the average which favors such a view, but later examples will show that brash woods often have even longer fibers than strong specimens of the same species. This idea is also supported by comparative lengths of fibers in different woods. Figure 7 shows diagramatically the relative length and breadth of the strengthening elements in the three woods mentioned. The longest one represents a spring tracheid of *Taxodium distichum* and measurements will show that the length is about eighty times the diameter, twice as long as are the fibers of *Liriodendron,* and four times as long as those of *Fraxinus americana;* figures which do not argue well for a relationship between short fiber length and brashness.

Another reason opposed to the above view is that the radial rows of cells do not end in the same horizontal plane but overlap as can be seen by a reference to any tangential section of coniferous wood. Consequently any weakness due to an interlocking of the tracheids would be uniformly distributed throughout the stick rather than restricted to some particular zone. Observations by Miss Gerry on the relation of fiber length to strength of timber show a similar lack of affinity.[2] To quote direct: "The relation between the fiber length and the strength values of the wood was indeterminate; no direct effect dependent on length alone could be found."

[2] Gerry, Eloise. Science N. S., Vol. XLI, No. 1048, January 29, 1915.

That bordered pits are regions of danger is well known and consequently comparative counts of their distribution were made for two sections of *Taxodium*. In the average tracheid shown in figure 7 there are about 500 bordered pits scattered over the two radial walls. In the wood shown in figure 1 they averaged 50 to the mm. on one side of the spring tracheids while the brash one showed on average of about 70 to the mm. In the summerwoods of the two sections the proportion was about 17 to 40. This difference in the number of bordered pits, each one a source of weakness, becomes even more striking when it is associated with the relative proportions of late growth in each, which was in the one case 38 per cent and in the other 2 per cent, thus producing a volumetric relative distribution of 3 to 7 in the strong and brash timbers respectively, and since this numerical difference is also associated with the larger size of those in the springwood, the effect on strength is even greater than numbers alone would indicate.

In summing up the features characteristic for *Taxodium distichum* it would appear that the factors which are influential in determining brashness are: the amount of summerwood, the thickness of the cell walls, and the number and size of the bordered pits. The specific gravity, being as it is but an outward manifestation of the anatomical organization, can not be included among the sources of weakness; a fact, however, which in no way minimizes its value as an indicator of the fitness of wood for structural purposes.

The tulip poplar, *Liriodendron tulipifera*, is one of the most variable as well as one of the most treacherous of woods. Some sticks are heavy and strong while others are weak and brash. The broken surfaces of the two types of tulip poplar are very characteristic as can be seen by a reference to figures 9 and 12 which show breaks typical of weak and strong woods. Both were examined microscopically under strong reflected light in order to determine their most vulnerable points. In the brash one, illustrated in figure 9, the vertical elements almost without exception show a transverse break while the short splinters exhibit a tendency to split along the vessels or through the rays. The fibers when not broken abruptly are for the most part separated through the central part of the cell rather than through the middle lamella, and cases where they are pulled apart at the ends are rare. In figure 9 a hand lens will show the vessels and rays which have been broken so smoothly that every antomical detail is visible. In general the wood

rays fall in a direction perpendicular to the long axis, and the individual cells split rather than pull apart at the point of union with a neighboring cell. In a brash wood, therefore, it would appear that the vessels are especially weak since they are the first to buckle and break under the strain. The ray cells offering a line of least resistance at right angles to that of the other elements tend toward weakness in proportion to the amount of space they occupy. The fibers, the last to give way, in weak woods split through the walls and the resistance they offer depends largely upon the amount of woody substance present. The broken surfaces illustrated in figure 12 show a break characteristic of a strong wood. Here only a small proportion of the elements are broken transversely as they are in the brash one, but rather in a somewhat diagonal-vertical line so as to form numerous small splinters. As in the first case vertical rupture is usually through the vessels, whose thin walls offer a low resistance to flexure or compression. Failure along the rays is similar to that already described. The fibers are as usual the last to break in strong woods, and tend to separate rather than to split through the wall, and, as before, pulling apart at the ends is rare. Whenever the ends are broken the line of rupture is for the most part diagonal and many were seen where the ends were much frayed. Observations similar to these are recorded by Brush in his paper on the anatomy of mechanical failure.[3] Since failure appears to follow the vessels and rays more generally than it does the fibers, it seems safe to assume that the proportional amount of ray and conducting tissue in diffuse porus woods are among the most important factors in determining strength or brashness.

A photomicrographic transverse section of a strong tulip poplar, *Liriodendron tulipifera*, is shown in figure 3, and it will be observed that the fibers are thick-walled and occupy a large proportion of the volume. The vessels are small and well separated but the rays, unlike those illustrated for the bald cypress, tend to spread at the juncture of the two annual rings and are in general of the diffuse multiseriate type. A band of thick-walled parenchyma appears at the end of the ring but it is doubtful if this narrow plate of storage tissue has much effect upon strength as in neither case where broken specimens were examined did rupture seem to follow the end of the annual zone. Figure 4 shows a similar section of a brash tulip poplar, taken from

[3] Brush, W. D. A Microscopic Study of the Mechanical Failure of Wood. Review of Forest Service Investigations, Vol. 2, 33-42, 1913.

the same stick as that illustrated in figure 9. In this one the vessels occupy the major portion of the field, and consequently augment the tendency to brashness. The fibers in addition to being few in number are also thin-walled. The other structural features do not differ to any large extent from those already mentioned and consequently do not deserve further consideration.

Table 2 will aid in clarifying the relation as between structure and brashness. The specific gravities show a proportion similar to that mentioned in Table 1, and the percentage of fibrous tissue and the thickness of the fiber walls shows a like proportion of roughly 2 to 1. In both, the diameter of the fibers is nearly equal, and in this way follows the general rule of the constancy of cell size in species. The other measurements mentioned are not as important, and the record in the table will serve for comparisons but need not enter into the discussion.

TABLE 2.—*Liriodendron tulipifera L. Measurements in millimeters.*

Character of wood	S. P. G.	Per cent fibers	Per cent rays	Thickness of the fiber wall	Length of fibers	Diameter of fibers	Height of rays	Diameter of vessels	Rings per cm.
Strong.......	.63		18	0.007	2.10	0.03	0.74—0.05	0.08	2.4
Brash........	.31	31	14	0.003	1.49	0.03	1.00—0.05	0.10	12.0

Figure 7 shows diagramatically one of the strong fibers of the tulip poplar. The shaded portion represents the relative thickness of the wall and the width of the lumina. Modifications of the ends of the fibers which serve to increase cohesion are shown in which one is forked and one sawtoothed.

An interesting development in relation to the validity of fiber length in reference to brashness was shown by a specimen not included in the table where a specific gravity of .46 was associated with a fiber length of 1.34 mm., or in fact, shorter than they were in the light weak wood mentioned in Table 2 where the relation was as .31 to 1.49.

In *Liriodendron*, therefore, mutability in strength appears to be closely related to the proportion of fibrous and conducting tissue, the thickness of the fiber walls, and the volume occupied by the vessels and rays. Tulip poplar wood in general shows great variation in its

resistance to stress, and consequently should be used with caution wherever it is likely to develop severe strains.

The white ash, *Fraxinus americana,* was chosen as an example of a ring-porous wood, not only because of its importance in industry, but also because of variability in its structure and tendency to be brash. Figure 5 shows a cross-section of a strong white ash timber cut so as to include the end of one annual ring and the beginning of the next. Here, owing to a further specialization of the conducting tissue, the organization is more complicated than that shown in the previously mentioned species. In the early springwood the vessels are large, as can be seen by the portion of one included in the upper part of the picture or even more clearly by those represented in the lower portion of figure 8, in which an entire annual ring is included. In the summerwood, on the other hand, the vessels are small and more widely separated. Such a restriction of the large conducting elements to one region creates a zone of weakness, a feature which has for a long time been utilized by basket makers. The rays are of the diffuse multiseriate type quite similar to those appearing in *Liriodendron* except for certain diagnostic differences. The multiseriate character is even better shown in figures 10 and 11 which represent their contour in tangential section. Other storage cells, vasicentric parenchyma, surround the vessels and tend to increase the susceptibility to brashness in proportion to their volume. The fibers are of two types. In the springwood they are short, thin-walled, and blunt at the ends, while those in the summerwood are long, thick-walled, and attenuate, both types of which are shown conventionally in figure 7, and it will be observed that end modifications in the longer summer fibers are very similar to those already mentioned as occurring in tulip poplar.

As in the two cases mentioned above, thinness of the fiber wall is one of the most important indications of brashness, while the relative proportion of short spring fibers and long summer strengthening cells is of equal importance. This is more clearly shown in figure 5 which represents a strong block of white ash with its thick-walled summer fibers, and in figure 6 which pictures a weak specimen with thin-walled cells in the same region. The more exact differences between these two woods are clearly set forth in Table 3 which shows the following correlations: a specific gravity of .70 is associated with a summer fiber wall thickness of .006, a percentage of ray tissue of 10 and a percentage of summerwood of 70. The brash one on the contrary shows

a specific gravity of only .36 which in its turn is associated with a summer wall thickness of .002, 19 per cent of ray tissue, and 20 per cent of summerwood. The other measurements mentioned in the table are not as significant, and need no further attention.

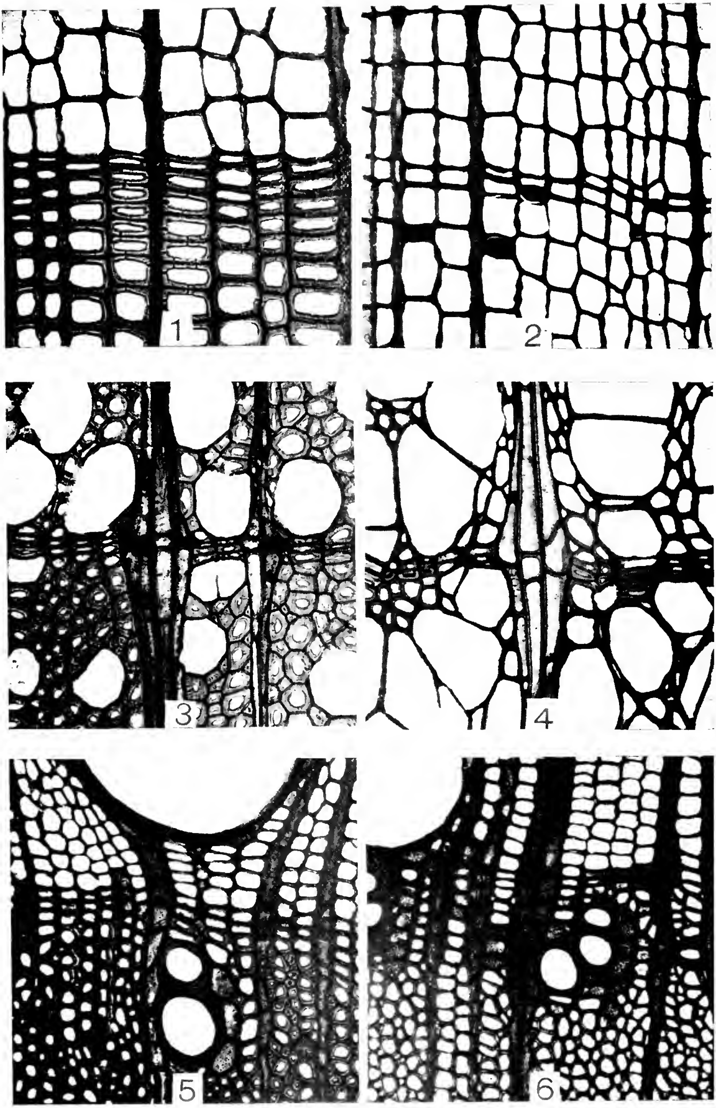
TABLE 3.—*Fraxinus americana L. Measurements in millimeters.*

Character of wood	S. P. G.	Per cent summer-wood	Per cent rays	Thickness of the wall of summer fibers	Thickness of the wall of spring fibers	Length of the summer fibers	Length of the spring fibers	Diameter of the summer fibers	Diameter of the spring fibers	Height of rays	Diameter of the spring vessels	Diameter of the summer vessels	Rings per cm.
Strong.....	.70	70	10	0.0065	0.0025	1.64	0.55	0.017	0.02	0.32—0.17	0.30	0.08	5
Brash......	.36	20	10	0.0020	0.0016	0.72	0.39	0.02	0.03	0.27—0.15	0.16	0.07	3

The amount of ray tissue having as it does a very definite bearing upon the problem should not go unnoticed. Variation is very marked in the white ash, as is shown in figure 10, a strong wood where 10 per cent has been differentiated for storage, and in figure 11 a weaker one where the volume reserved for such a purpose is about 30 per cent, with its concomitant diminution of the fibrous elements and resistance to stress.

The rate of growth in ring-porous woods is of interest since it has long been known that strength in hardwoods is more or less coincident with rapidity of growth. The anatomical reasons for such a belief are well shown in figure 8, which represents a cross-section of a suppressed *Fraxinus*. It will be observed that of the entire year's increment over two-thirds of the area is occupied by the spring vessels and short fibers, while the remainder is possessed by the small summer vessels and thick-walled fibers. In those woods where growth has been more rapid, the area reserved for conduction is about equal to that shown in the print, while the increased width is added to the stronger summer portion. Even though in general increase in width means increase in the number of summer fibers, it does not always follow that such woods will be strong, since the fibers may be thin-walled similar to those shown in figure 6. In the trade, ash of this character is known as "pumpkin ash," a term by no means restricted to the wood of *Fraxinus profunda*.

Brashness in white ash woods, therefore, appears to be associated primarily with a narrow summer growth, with thin fiber walls, with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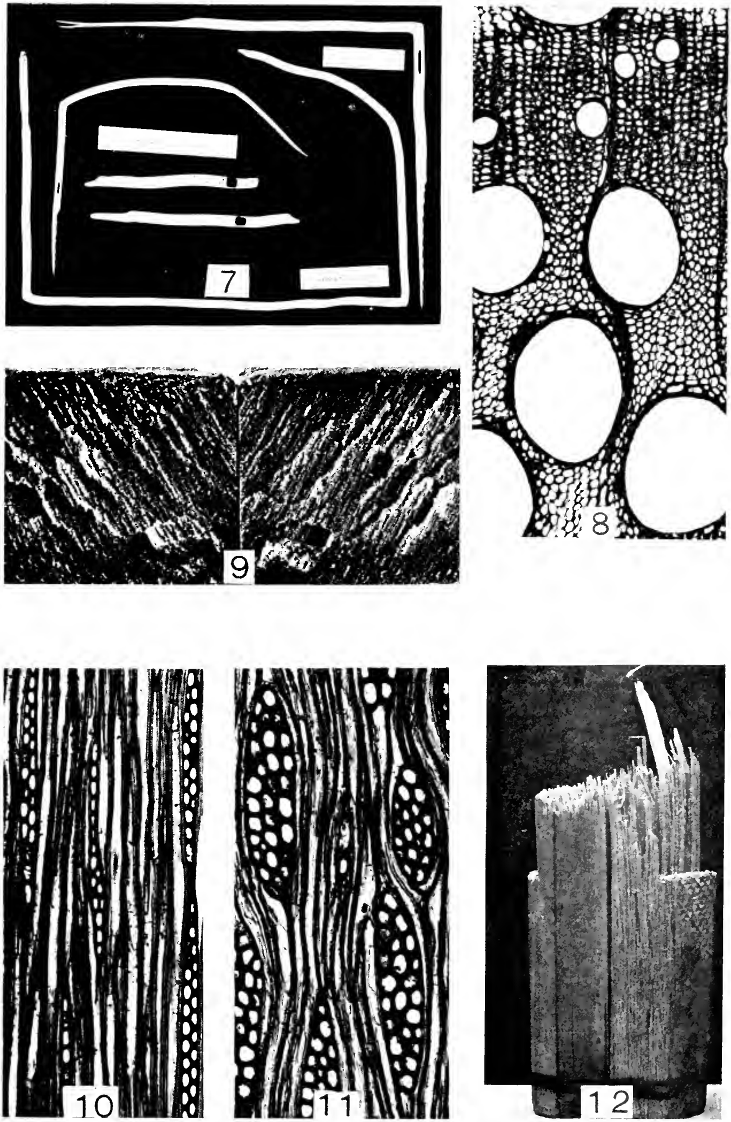
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the large size and general distribution of the vessels and upon a high percentage of the wood rays. To be sure, other structural features have their influence, such as the diameter of the fibers, and the amount of vasicentric parenchyma around the vessels, but in general their control is slight in comparison with those just listed.

The above observations have shown that anatomical variations play an important rôle in determining strength or weakness in wood. In the coniferous group, the relative proportion of the thick-walled summer tracheids, and the thin-walled spring cells is of the utmost importance. A large percentage of late tissue is indicative of strength and for this reason the yellow pines are structural timbers *par excellence*. In the same way the small band of thick-walled tracheids at the end of the annual ring in the redwood militates against its use where a high resiliance is necessary. Very closely associated with the proportion of summerwood and springwood, is the thickness of the tracheid wall, which has been shown to be roughly proportional to specific gravity. Two other structures which always reduce strength as they increase in number or volume are the storage rays and the bordered pits. The rays are not as important in the softwoods as they are in the hardwoods, since they are practically always uniseriate in the Pinaceous type, and the volume of the tissue specialized for conservation is always small. The bordered pits are more important, since they form actual holes in the wall and upon failure are regions of primary rupture. Consequently the greater the size and number of the bordered pits the greater will be the susceptibility to brashness as was numerically shown in the case of the bald cypress.

In the diffuse-porous woods, the number and distribution of the fibers has perhaps the greatest influence on strength. The stronger woods show a high volumetric per cent of strengthening cells and a correspondingly smaller area occupied by vessels and rays. The thickness of the fiber walls is of equal importance, since it determines the amount of woody substance which of course is the ultimate test for strength or brashness. The influence exerted by the rays and other tissues depends upon their volume and naturally increases the liability to failure in proportion to the space they occupy. Brashness in diffuse-porous woods, therefore, depends primarily upon the number and size of the vessels, upon the volume of fibers, upon the thickness of the fiber walls, and upon the number and size of the rays and other parenchymateous regions.

The only new feature appearing in ring-porous woods which differs from those already described for the other types, is the ring-porous character of the annual increment of growth. In general, the width of this area of large cells differentiated for conduction appears to be quite constant and independent of the width of the ring. In slow-growing woods the volume of fibers and small summer vessels is normally small, and such timbers tend to be weak, while in rapid-growing trees the strengthening tissue is much increased in amount and naturally enough such woods are strong.

There are certain fundamental objections to the conception that short fibers are necessarily associated with brashness, since the tendency for the fibers to become shorter in the hardwoods than they are in the conifers is in reverse ratio to the tendency for the increase in strength as between the two types of wood. The radial rows of cells do not end in one plane, but are uniformly distributed so that there would be no localized line of weakness due to an inclination to offer a lower resistance to pressure where the fibers are joined. And finally, observations of broken brash and strong weeds show that the fibers do not to any large extent pull apart at the ends, but break, split longitudinally, or separate along the middle lamella subsequent to failure in the vessels and rays.

To be sure, there are other causes for brittleness in wood, such as incipient decay, improper drying, and the like, which have not been included in the discussion since they represent defects which are acquired, rather than inherent, and consequently should not be enumerated among the fundamental anatomical variations responsible for brashness.

CONCLUSIONS

1. Brashness is increased by a decrease in the amount of summerwood, by a decrease in the thickness of the tracheid or fiber wall, by a decrease in the volume of the fibers, by an increase in the volume of the wood rays and storage parenchyma, and by an increase in the number and size of the bordered pits.

2. In the conifers the proportion of thick-walled summer tracheids and thin-walled spring tracheids determines strength or weakness except as this may be influenced by the rays, resin canals, and storage parenchyma. In the diffuse-porous woods the percentage of fibers, the thickness of their walls, and the volume of the rays and vessels

bear a like relation to resistance. In the ring-porous woods there is added a new feature, the width of the specialized summer area. This area (the spring increment being constant) increases the tendency to brashness as it decreases in amount.

3. Failure in wood either due to flexure or compression is directed by the vessels and rays. The fibers, the last to give way, break horizontally, split in the thin-walled cells, or separate along the middle lamella in the thick-walled type. Separation at the ends is uncommon.

4. Variations in the specific gravity is quite closely proportional to variations in the volume of the fibers and the thickness of the lignified walls, and less frequently inversely proportional to the volume of the vessels and rays. Fiber length varies independently of variations in specific gravity, and cell size is more or less constant without regard to weight.

5. The length of the fibers is not important in determining brashness.

DESCRIPTION OF FIGURES

1. *Taxodium distichum* (L) Rich. A transverse section of a strong wood showing broad thick-walled summer area. X 150.

2. Same: A transverse section of a brash wood showing narrow thin-walled summer area. X 150.

3. *Liriodendron tulipifera* L. A transverse section of a strong wood showing thick-walled fibers and small, well-separated vessels. X 150.

4. Same: A transverse section of a brash wood showing thin-walled fibers and large contiguous vessels. X 150.

5. *Fraxinus americana* L. A transverse section of a strong wood showing thick-walled summer fibers and two types of vessels. X 150.

6. Same: A transverse section of a brash wood showing thin-walled summer fibers and two types of vessels. X 150.

7. Comparative fiber dimensions of *Taxodium distichum*, *Liriodendron tulipifera*, and *Fraxinus americana*.

8. *Fraxinus americana* L. A transverse section of a slow-growing wood showing a complete annual ring with a narrow band of summer tissue. X 50.

9. *Liriodendron tulipefera* L. The broken ends of a brash wood, details of which may be seen with a hand lens. X 1.

10. *Fraxinus americana* L. A tangential section of a strong wood showing narrow diffuse biseriate rays. X 100.

11. Same: A tangential section of a brash wood showing diffuse multiseriate rays. X 100.

12. *Liriodendron tulipifera* L. A photograph showing the broken splintered end of a strong wood. X 1.

TEMPERATURES FATAL TO LARVÆ OF THE RED-HEADED ASH BORER AS APPLICABLE TO COMMERCIAL KILN DRYING

By F. C. Craighead, *Bureau of Entomology, and* W. K. Loughborough, *Forest Products Laboratory*

The demand for seasoned ash stock during the past few years necessitated the extensive use of kiln-dried material. The attention of the Bureau of Entomology was called to several cases where manufacturers, using such material in aircraft construction, reported continued injury by the red-headed ash borer (*Neoclytus erythrocephalus* Fab.) after the wood was kiln dried. As practically no information was available as to what temperatures are fatal to these wood-boring insects, a co-operative project with the Forest Products Laboratory of the Forest Service was suggested by the Branch of Forest Insects of the Bureau of Entomology to ascertain the fatal temperatures and determine if the temperatures in the commercial kiln processes recommended by the Forest Products Laboratory are sufficient to destroy the borers.

The purpose of these experiments and the entomological features were outlined by the Branch of Forest Insects which also furnished the material. The methods of conducting the experiments were outlined by the Forest Products Laboratory in accordance with the laboratory facilities and commercial practices in kiln drying.

Subjecting wood to dry kiln temperatures for the sole purpose of destroying wood-boring insects is, of course, only necessary in cases where more practical methods of preventing the injury have been overlooked or can not be applied under existing circumstances. In these cases considerable injury is already under way which should have been avoided and kiln processes will, therefore, only arrest the damage and prevent further injury by the borers. However, practically no damage from insect attack need be expected if the lumber is kiln dried shortly after it has been felled.

The seasonal history and methods of preventing losses by this insect, as well as another insect, "the banded ash borer" (*Neoclytus capræa* Say), causing similar injury, have been discussed in publications of the

Bureau of Entomology. These wood-boring grubs develop from eggs laid by beetles in crevices of the bark. The banded ash borer flies in the early spring, in the extreme South, from the first part of March to the first part of April, while in the Northern States it flies from the middle of April through May. In the South the first flight of the red-headed ash borer coincides with that of the banded ash borer; however, the red-headed borer continues to appear all summer until the middle of October, while in the North it appears only during June. In those States between the northern and southern limits of distribution the dates of flight are intermediate. These beetles will lay eggs only on logs which are not seasoned, i.e., the inner bark must be still sappy; also the bark must be present. After the eggs hatch the larvæ bore beneath the bark from 4 to 6 weeks before entering the wood.

To avoid the injury by these borers it is therefore essential that the logs be removed promptly from the woods during the flight period of these beetles or not later than 4 to 6 weeks after the earliest dates of flight. They should be promptly sawed or the bark removed before storage, or else they should be placed in water. Four months' submergence in water makes the wood unattractive to the borers and will prevent future attack.

Material.—The material used in these experiments consisted of approximately 20 pieces of ash, 3 feet long, cut from young trees from 3 to 8 inches in diameter. It was cut in April, 1920, and held at the Bureau's Eastern Field Station, East Falls Church, Virginia, where it was attacked in June by the borers. It was shipped in September to the Forest Products Laboratory.

Methods of Sawing.—Inasmuch as this borer confines its activities to the sapwood, it was essential that the sapwood be unmolested as far as possible. Therefore, the 3-foot sections of the trees were merely quartered or halved instead of being sawed into boards of a given thickness.

Condition of Larvæ.—The majority of the larvæ were full grown in their pupal cells in the wood, while a smaller percentage were still feeding in the wood. The treatments were observed on both stages of larvæ, but no noticeable differences in results were observed.

Methods of Procedure.—This study was conducted with a view of determining not only the effect of temperature but also that of relative humidity on the borer. In order that these factors might be isolated, three types of experiments were made.

One set of experiments consisted of treating the infested wood in a kiln held at different temperatures and for various periods. The larvæ were then chopped out and their condition noted. In the other two groups of experiments, the naked larvæ were exposed directly to the different temperatures for definite periods. In one case the larvæ were placed in water of determined and regulated temperatures, and in the other the larvæ were subjected to the dry heat of an electric oven.

In each of these groups of experiments, the condition of the larvæ was noted at the time the treatment was concluded. They were then placed in small glass vials, corked with cotton and held until the larvæ turned dark, due to death, or until activity was noted. Consequently, in some cases it was clearly evident that the larvæ were dead a few minutes after removal from the wood while in other experiments or on other specimens 48 hours were required to determine with certainty the ultimate effect the treatment had on the larvæ.

In the kiln experiments the temperatures were thermostatically controlled and were recorded by a Bristol recording thermometer. These temperatures were also checked by maximum and minimum thermometers. Previous experiments have shown that the temperature within a piece of wood ultimately reaches approximately the dew point of the surrounding air. Therefore, the relative humidity was held at 100 per cent so that the temperature in the wood might be the same as that of the air surrounding the wood. It has also been determined by previous experiments that heat moves through wood slowly—1-inch stock coming to a uniform temperature in about an hour. In view of the fact that the majority of the larvæ were confined to the outer 1 inch of the specimens treated, it was concluded that an hour's treatment at a certain temperature merely brought the wood surrounding the larvæ up to the kiln temperature.

Kiln runs were made at different temperatures and periods of time starting at 160° F. for 1 hour and lowering to 110° F. for 70 hours. In all tests above 128° F. the borers were killed in the experimental runs in periods varying from 1 to 2 hours. Four hours at 120° F. and 16 hours at 116° F. killed only about 50 per cent of the larvæ, while 19 hours at 120° F. killed all the larvæ. One hundred per cent mortality was also secured in 45 hours at 116° F. and in 70 hours at 110° F.

In the water experiments the larvæ were first chopped out of the wood and, if alive and active, were then submerged and held at definite known temperatures for various periods. Temperature and time periods varying from 1 minute at 117° F. to 60 minutes at 125° F. were used. Ten minutes' exposure at 125° F. killed only 50 per cent of the larvæ, while 1 hour killed 75 per cent. Thirty minutes at 120° F. also killed 75 per cent, while 2½ hours at the same temperature killed 100 per cent. All the foregoing temperatures caused cessation of activities within 2 minutes.

In the dry-air experiments the naked larvæ were held at a desired temperature for a definite period. An electrically heated oven was used for these tests and its temperature was determined by an enclosed mercury thermometer which could be read from the outside. Temperatures from 116° to 125° F. and time exposures from 2 minutes to 1 hour were used. Ten and one-half minutes' exposure at 120° F. resulted in death, as well as 122° F. for 5 minutes and 125° F. for 2 minutes. On the other hand, 120° F. exposure for 2, 3, and 4 minutes did not kill the larvæ; nor did 118° F. for 16 minutes. This last temperature (118° F. for 16 minutes) did not cause cessation of activities. All temperatures of 120° F. or above caused cessation of activities after 2 minutes' exposure.

CONCLUSIONS

The outstanding deductions from this study were that the larvæ of the red-headed ash borer are killed in any kiln process which can be considered practical for the seasoning of ash, regardless of the thickness. Even temperatures as mild as those used in Schedule 2, Specification 20,500 A, Bureau of Aircraft Production, which range from 105° to 135° F., are fatal to them. Subjecting infested material to a temperature of 116° F. for 45 hours resulted in 100 per cent death of the larvæ. Temperatures of about 125° to 130° F. will kill the larvæ within an hour after the wood becomes heated through.

Dry heat is fatal to the larvæ at a lower temperature than hot water for the same period.

Water at 125° F. for an hour was fatal to only 75 per cent of the larvæ treated, while dry air at 125° F. resulted in 100 per cent death in 2 minutes. The time required to produce 100 per cent death in dry air at 120° F. was 10½ minutes, while the same effect was produced in water only after 2½ hours. These time limits are not to be

considered absolute limits, but merely to show in a general way that dry air is much more effective than water in producing the death of the larvæ at lower temperatures.

In the dry-air experiments several larvæ of *Xylotrechus colonus* Fab. from hickory were used and the effects were similar to those produced on *Neoclytus erythrocephalus.* Although it is hardly likely that these same temperatures will be equally fatal to other insects such as those native to the Southern States, it is probably safe to assume that if commercial kiln schedules above Schedule 2 are used on other woods, other species of borers that may be in the wood will be killed.

FURTHER NOTES ON INTERCELLULAR CANALS IN DICOTYLEDONOUS WOODS

(Contribution from the Yale School of Forestry, No. 11)

By Samuel J. Record

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The identification of woods is purely a matter of elimination. Everyone interested in the subject is on the alert for features and combinations of them which will demarcate the smallest possible groups. Two such characters, which have proved very helpful to the writer in narrowing the field in the identification of tropical woods, are "ripple marks" or striations resulting from the storied structure of the elements, and intercellular canals, variously known as resin ducts, gum ducts, gum cysts, gum veins, etc. These ducts are as characteristic of the dipterocarps, for example, as they are of pine and afford one of the most reliable means for distinguishing some of the so-called "mahoganies" from the genuine.

For several years the writer has been collecting data on the nature and scope of occurrence of these canals and their dependability for diagnostic purposes. They are of two general kinds, vertical or axial and horizontal or radial, the latter being found in the rays. The two kinds are very rarely, if ever, found in the same wood, therein differing from the condition in the ductiferous woods of the conifers. The vertical canals are of two types, the normal, and the traumatic or pathological. The latter are of sporadic occurrence and are, of course, likely to be absent in any given specimen, particularly if it is small.

The results of the first observations were embodied in a paper [1] published in 1918. Since then many additional woods have been studied and valuable new sources of information have become available. The present paper consists mainly of notes which have been made from time to time during the past three years. It is hoped that they will stimulate further interest on the part of other investigators.

Anacardiaceæ.—A specimen of "malabog" from the Philippine Islands (Yale No. 2201), *Parishia malabog*, and two specimens of

[1] Intercellular canals in dicotyledonous woods. Journal of Forestry, 16:4:428-441, April, 1918.

"pao pombo" from Brazil (Yale Nos. 3490 and 3505), *Tapirira guayanensis* or *T. marchandii*, show ducts in rays which produce on tangential surface oily specks readily visible with lens and sometimes without it.

Radial canals appear conspicuously on the tangential surface of a specimen labeled "hoobooraballi" from British Guiana and which presumably belongs to this family.

Moll and Janssonius (16, II, p. 442) report canals in the rays of the following: *Buchanania florida*, *Gluta renghas*, *Spondias mangifera* var. *javanica*, *S. dulcis* var. *acida*, and *Odina wodier* var. *wirtgenii*.

Vertical canals have been found only in *Drimycarpus racemosa*. (See former paper, p. 436.)

Radial canals have been found in representatives of the following genera: *Astronium*, *Buchanania*, *Garuya*, *Gluta*, *Koodersiodendron*, *Odina*, *Parishia*, *Rhus*, *Schinopsis*, *Schinus*, *Spondias*, and *Tapirira*.

Araliaceæ.—The occurrence of radial canals in *Heptapleurum ellipticum* and *Arthophyllum diversifolium* has been noted and the structure described by Moll and Janssonius (16, III, pp. 640, 645, 647, 673, 681). The latter instance confirms the opinion of the present writer (Journ. For., 1918, p. 438) that Viguer's "poches secretrices" are true radial ducts.

Only radial canals have been observed in this family. The genera so far reported as having them are: *Arthophyllum*, *Cheirodendron*, *Didymopanax*, and *Heptapleurum*.

Bombacaceæ.—A specimen (Yale No. 4052) of so-called "ceiba wood" from commercial sources, apparently belonging to this family but not positively identified, shows very distinct concentric layer of dark colored gum ducts, resembling those in eucalyptus.

A Colombian specimen (Yale No. 1540) of "ceiba," identified as *Ceiba pentandra*, shows a layer of gum ducts, in some places several rows thick, presumably of pathological origin.

The wood mentioned in the writer's former paper under the name of *Pachira* sp. belongs to the new genus *Bombacopsis*.

All ducts found in woods of the *Bombacaceæ* are vertical and of the gummosis type. The woods are very soft.

Borraginaceæ.—In a market specimen (Yale No. 4104) called "Brazilian walnut" and identified by the writer as *Cordia Gœlldiana*, the "frei-jo" or "frei-jorge" of Brazil, small ducts, presumably of trau-

matic origin, filled with a dark resinous material are arranged in a compact peripheral row. They occupy the entire space between the rays but no interruption of the rays was noted.

Burseraceæ.—In specimen (Yale No. 3677) of *Elaphrium simaruba* from the Guatemala-Honduras boundary, radial canals are common. They are visible with lens.

In two Brazilian woods labeled respectively "imburana" (Yale No. 3410) and "umburana" (Yale No. 3415), believed to be *Bursera* sp., ducts are present in some of the rays. They are barely visible under lens on tangential surface as dark specks in the rays.

In a specimen of *Santiria nitida* (Yale No. 2224) a few scattered radial ducts are barely visible without lens. One of these canals was figured in the original paper but no reference to it was made in the text.

Scattered radial canals, barely visible to the unaided eye, were observed in the Philippine "bogo" (Yale No. 2223), *Garuga* sp.

Dr. Henry H. Dixon of Trinity College, Dublin, states in a letter of January 20, 1919, that he has observed intercellular canals in *Protium altissimum*. It is presumed that he refers to vertical canals resulting from injury.

Radial canals have been observed by the writer in representatives of four genera, namely, *Bursera* (?), *Elaphrium*, *Garuga*, and *Santiria*. Traumatic vertical canals have been reported by others[1] in *Canarium* and *Protium*.

Combretaceæ.—Vertical canals, of the gummosis type, have been observed by the writer in various specimens of *Terminalia* spp. In *T. bialata* (Yale No. 3878) from India and *T.* sp. (Yale No. 2238) from the Philippine Islands, there are direct evidences of wounding. Other specimens in which this feature was observed are *T. belerica* (Yale No. 3875) from India, and the "araça de agua," *T.* aff. *januarensis* (Yale No. 3940), from the region of Bahia, Brazil. A market specimen of "araça" (Yale No. 3105) from Rio de Janeiro shows two compact peripheral arcs of ducts, in one instance running the full length of the piece, namely, eight inches. This wood is unquestionably *Terminalia* though probably not of the identical species of the other Brazilian wood mentioned. In all of the above, the ducts are small and, though distinct, are not conspicuous. The contents are gummy and mostly of a dark reddish color.

Terminalia is the only genus of this family in which ducts have been noted. Since they are traumatic they are likely to be absent, particularly in small specimens.

Cornaceæ.—The presence of numerous vertical ducts occurring normally in the secondary wood of *Mastixia trichotoma* and *M. rostrata* has been noted by Moll and Janssonius (16, III, p. 438). Some authors classify *Mastixia* under the Dipterocarpaceæ, but the structure of the wood, except for these ducts, indicates Cornaceæ. In this connection see also Solereder (2, p. 438).

Mastixia is the only genus in which canals have been noted.

Hamamelidaceæ.—Moll and Janssonius (16, III, pp. 304, 321) found schizo-lysigneous vertical ducts in single concentric rows at the limit of growth rings in *Altingia excelsa*. Radial canals were not found. In the variety *excelsa*, however, schizogenous canals were present in a few of the rays of all three specimens examined (16, III, pp. 318, 323).

Vertical canals of the gummosis type have been noted by the present writer and others in *Liquidambar* spp. (see former paper p. 433). The only reference to canals in the rays is by Moeller (6, p. 13), who claimed to have found secretory cavities in the bark in communication with vertical canals in the wood.

In her paper on storax production of the red gum, *Liquidambar styraciflua*, Miss Gerry (27, p. 19) says: "In the wood formed after tapping, abnormal structures from which storax exudes were produced near the wound. These are similar to the induced vertical resin ducts found in turpentined pines. No horizontal gum ducts were formed."

Leguminosæ.—A small block of wood of *Andira savanarum* (Yale No. 2988) from Panama contains vertical gum ducts with reddish contents; they are evidently traumatic.

A Philippine wood specimen of *Sindora inermis* (Yale No. 2355) shows vertical ducts normally as in *S. supa* previously described (former paper, p. 434). The same is true, according to Moll and Janssonius (16, III, pp. 142, 144), of *Sindora sumatrana*.

Two specimens of *Hymenæa courbaril*, one from Costa Rica (Yale No. 2697), the other from the Amazon region of Brazil ("L. Agassis" col. No. 35), contain vertical ducts which are presumably of traumatic origin.

A specimen of "purple heart," *Peltogyne* sp. (Yale No. 5[illegible]) from Barbados, origin believed to have been Demerara, shows a concentric row of vertical ducts, presumably traumatic.

Hardwickia binata has, according to W. S. Jones (17), pathological secretory cavities "arranged closely side by side in a peripheral order, much as one finds the secretory cavities in *Eucalyptus*." Solereder (2, p. 905) says: "According to my own investigation, *Hardwickia binata* Roxb. has secretory cavities only (situated in the primary cortex and sometimes also in the pith and parenchymatous pericycle), interxylary secretory canals being absent."

With possibly one exception noted in the former paper (p. 433) only vertical canals have been observed in the Leguminosæ. They are of two classes: (1) those occurring normally as in *Copaifera, Daniellia, Eperua, Kingiodendron, Prioria, Oxystigma,* and *Sindora;* (2) those of traumatic origin or gummosis type as in *Andira, Hardwickia, Herminiera, Hymenæa,* and *Peltogyne.*

Lythraceæ.—Schizogenous canals in the rays of some but not all of the specimens of *Crypteronia paniculata* var. *leptostachya* have been noted by Moll and Janssonius (16, III, p. 585). No ducts were found in *C. paniculata.*

Malvaceæ.—Von Höhnel (21, p. 42) says that he found in the wood of *Thespesia populnea* many secretory cavities with orange-yellow (resinous?) contents, which in the dry wood is homogenous and fills the entire cavity. They are situated in the wood parenchyma and the medullary rays, solitary or in short rows. The present writer assumes that what is meant is that the ducts are vertical and in their lysigenous development interrupt the rays but do not run horizontally in the rays. The latter are given as 5-10 cells high and 2-3 cells wide.

Meliaceæ.—Vertical canals such as described for *Swietenia mahagoni* have been noted by the writer in *S. macrophylla, S. candollei, Carapa guianensis,* and *Khaya senegalensis.*

Moll and Janssonius (16, pp. 116, 129, 135) report vertical schizo-lysigenous canals in *Melia bogoriensis, Sandoricum indicum, Carapa obovata, Cedrela febrifuga* vars. *glabrior* and *velutina.*

Dixon (18, p. 447) says of *Swietenia mahagoni* on cross section: "Laminar parenchyma 1-12 cells thick, sometimes containing intercellular spaces, containing dark substance, in tangential series." Same (p. 449) re. *Cedrela odorata:* "Laminar parenchyma 2-6 cells thick,

sometimes with intercellular spaces filled with deposit." Same (p. 459) re. *Khaya senegalensis:* "Laminar parenchyma rare or absent, sometimes with deposit of dark gum-like substance in intercellular spaces and forming a dark tangential band across section (Pl. XXX, fig. 49)." Same (p. 462) re. *Entandrophragma excelsum:* "There is rarely a continuous band of intercellular spaces in these laminae with dark deposit." Same (p. 471) re. *Cedrela toona:* "Laminar parenchyma occasionally in dense zone with schizogenous spaces filled with dark deposit." Same (p. 472) re. *Cedrela serrata:* "Circumvasal parenchyma narrow, laminae occasional on outside of growth-zone, about 10 cells thick, sometimes with schizogenous spaces filled with dark deposit.

Only vertical canals have been found in the woods of the Meliaceæ and they are of the gummosis type, at least their final stage indicates plainly the breaking down of the surrounding tissue. These canals are usually conspicuous and seriously weaken the resistance of material to longitudinal shear.

The genera reported are: *Carapa, Cedrela, Entandrophragma, Melia, Sandoricum,* and *Swietenia.* Further investigations will likely increase the list materially.

Moringaceæ.—Vertical canals were found by Moll and Janssonius (16, II, pp. 513, 515) in the wood parenchyma of *Moringa* sp. Through their lysigenous enlargement they broke down portions of the adjacent rays. They are apparently without contents. It is interesting to note that in this instance the canals, instead of being in rows or layers, as is usually the case, are scattered irregularly. (16 II, fig. 144, p. 514.) The presence of one or two gum canals in the pith only had been noted by previous investigators.

This family consists of only one genus.

Myrtaceæ.—In the former paper is this statement (p. 437): "Although secretory cavities occur in the leaf and ground tissue of the axis of this family, the writer has been unable to find references to secretory canals or cavities in the wood." Since then occasional references have been found in descriptions by various authors, notably Boulger (19) and Baker (26), who refer to the canals as "gum-veins." They are very common in the wood of many species of *Eucalyptus.* Boulger (19, p. 128) also refers to *Angophora intermedia* as "subject to gum-veins."

According to Moll and Janssonius (16, III, pp. 387-9, 403, 406, 412, 437-8, 486) vertical canals sometimes occur in *Rhodamnia cinerea* and

large, empty radial canals were found in *Leptospermum javanicum, Eugenia cuprea* (sometimes more than one in a ray), and *E. sexangulata.*

Rosaceæ.—The presence of canals and cavities of the gummosis type in the woods of the Prunoideæ is a matter for common observation. Such canals are, for example, very commonly found in the wood of *Prunus serotina.* The writer has also observed them in a Philippine specimen (Yale No. 1676) labeled "Luisin Gubat, Indet," and believed to be *Pygeum* sp.

Moll and Janssonius (16, III, pp. 207-263) have investigated the woods of two species and seven varieties and forms of *Pygeum* from Java. In *P. parviflorum* vertical gum canals in unbroken tangential lines were of common occurrence. In *P. latifolium, P. latifolium* var. *tomentosa* form *lanceolata,* and *P. latifolium* var. *nervosa,* radial canals without contents and said to be of schizogeneous origin were found. Of two different specimens of *P. latifolium* var. *tomentosa,* one contained the typical vertical gum ducts while the other contained schizogenous radial canals. In the latter specimen the rays averaged considerably larger than in the former.

The conditions in the Rosaceæ closely parallel those already noted for the Myrtaceæ.

Rutaceæ.—The occurrence of gum or mucilage canals has already been noted in species of *Xanthoxylum, Esenbeckia,* and *Fagara* (?). The writer has found them in three other woods, all from Brazil. A specimen of "guarantan" (Yale No. 3907), believed to be *Esenbeckia leiocarpa,* shows ducts as previously reported for *E. febrifuga.*

Specimens of *Balfourodendron Riedelianum* (Yale Nos. 3902, 3167) have vertical canals common in tangential rows in association with wood parenchyma. They are filled with a yellowish or brownish mass.

A market specimen of "pau amarello" (Yale No. 3929), identified as *Euxylophora paraënsis,* contains a patch of wood parenchyma (resembling a large pith fleck) with small ducts with reddish contents scattered in it. This structure was not observed in other specimens of this wood.

Sapindaceæ.—"The parenchymatous wood of *Dilodendron bipinnatum* is characterized by a kind of gummy metamorphosis, a substance resembling gum being excreted in the vessels and in canal-like cavities." Solereder (2, p. 233).

Simarubaceæ.—Vertical ducts in concentric series appear to be a fairly constant feature in the Brazilian "pao parahyba" or "marupa," *Simaruba amara*. The wood is nearly white, rather light and soft, and has distinct ripple marks.

Moll and Janssonius (16, II, p. 81) found vertical schizo-lysigenous canals in the layers of wood parenchyma in *Ailanthus malabarica*.

The occurrence of resin canals solely at the periphery of the pith in these two genera and at least nine others has been noted by various investigators (2, pp. 186-7; 861). Mucilage cavities have been found in the pith of certain genera.

Sterculiaceæ.—Vertical canals in a compact tangential row have been noted by the writer in a specimen of the Philippine "lumbayao," *Tarrietia javanica* (Yale No. 1160). They are much like those found in the Meliaceæ, are filled with dark reddish contents which make the layer prominent on longitudinal surfaces.

Solereder (2, p. 845) records the "occurrence of interxylary mucilage-canals in the older portions of the axis in *Brachychiton populneum* and *Theobroma Cacao* (Mangin)." Mucilage cavities have been observed in the wood (in the wood parenchyma or in the medullary rays) of the root in *Sterculia Balanghas, S. foetida, S. "monophylla," S. platanifolia, Brachychiton acerifolium*, and *B. populneum*.

According to Jones (17, p. 108): "*Heritiera Fomes* is another tree which seems to form interxylary cavities very frequently. These are also arranged peripherally, and when a number of rows appear in a cross section there is a slight danger of confusing them with open tissue marking commencement of periodic growth."

Vochysiaceæ.—In this family, according to Solereder (2, p. 104), "secretory organs . . . are represented by lysigenous mucilage-canals and mucilage cells, found in the axis. The mucilage-canals are, as a rule, present only in the pith. . . . The gum-canals of the wood, stated by Wille to occur in *Qualea Lundii*, Warm., appear to be of a pathological nature."

The present writer found vertical gum-ducts in a specimen of *Vochysia guatemalensis* (Yale No. 3708) from the Guatemala-Honduras boundary. In one place they are in a double layer and rather prominent. This wood is light and soft with abundant parenchyma.

GENERAL

A Brazilian specimen (Yale No. 3126) labeled "arruda brava" but not identified shows concentric rows of small ducts with here and there a larger resinous pocket. The ducts are apparently normal and it seems probable that the wood belongs in the group of Leguminosæ mentioned on page 434 of the former paper.

Dixon (18, p. 465) says in reference to a market specimen labelled "African walnut": "Parenchymatous laminae—often with black deposit in intercellular spaces." Of another specimen he says (p. 466): "Circumvasal parenchyma spreads tangentially to form laminae, which often develop intercellular spaces in tangential series, filled with dark secretion, and extends radially along rays." The identity of these specimens is unknown. Boulger (19, p. 322) mentions two woods known on the market as "African walnut," one (*Trichilia* sp.) belonging to the Meliaceæ, the other (*Boswellia Klainei*) to the Burseraceæ. Woods of both of these families are known to develop intercellular canals. According to Unwin (23, p. 326) the wood most commonly sold as African walnut is *Lovoa Klaineana* of the family Meliaceæ.

Dixon (18, p. 454) says in reference to a specimen from the Dublin National Museum, labelled "turiballi, uriballi or eureballv, or Guiana mahogany": "Rays uniform (except for occasional giant rays). . . . Giant rays with bowed sides, many cells across, with dark contents in middle cells, a circular curve or even a space." The identity of this wood is unknown, but the present writer is of the opinion that it belongs to the Anacardiaceæ.

With reference to conifers, the writer has noted greatly enlarged resin ducts in the fusiform rays of *Picea sitchensis*. These are scattered all through the specimen (which is a portion of an airplane strut) and are distinct to the unaided eye as dark specks or dots. They are of the shape described by Jeffrey (20) in a fossil *Sequoia* and by Jones (17) in *Cedrus*.

In a specimen of *Pseudotsuga taxifolia* (also part of an airplane strut) a slightly malformed portion was found which on tangential section is roughly circular and about one-half inch in diameter. In this region the rays are decidedly abnormal, being multiseriate (up to 7 cells wide) and up to 100 cells in height. Each of these enlarged rays usually contains a single small resin duct, though in some cases two were found, and in a few instances there was none. The wood outside this region was normal.

In the wood of *Pinus albicaulis* the writer has observed the abnormal development of wood parenchyma or resin cells described and figured by Somerville (24).

There is a close parallel between the conifers and dicolytedons in the formation of intercellular passages. For discussions of the origin and significance of such structures the reader is referred to the works of Newcombe (22), Kirsch (25), and the numerous authorities cited by the latter. Consideration of the phylogenetic significance of resin ducts in conifers cannot be complete without taking into full account the occurrence of similar structures in dicotyledons. Amplification of this point is not within the province of this paper.

SUMMARY

Intercellular canals or ducts with contents of a resinous, gummy, mucilaginous or other nature have been found in representatives (mostly tropical) of 23 families.

As regards position in the tree these canals are of two separate and distinct classes: vertical or axial, and horizontal or radial. As regards origin they may be schizogenous, lysigenous, or schizo-lysigenous. The ducts in the rays are mostly schizogenous; the vertical ducts are in most cases abnormal or pathological, often of the so-called gummosis type.

The only families in which canals are commonly found in the medullary rays are the Anacardiaceæ, Araliaceæ, and Burseraceæ. Canals are apparently of normal occurrence in certain representatives of seven families, namely, Anacardiaceæ, Araliaceæ, Burseraceæ, Cornaceæ, Dipterocarpaceæ, Leguminosæ (Cæsalpinioideæ), and Simarubaceæ. Only in the Dipterocarpaceæ are they the rule.

The list of families of the dicotyledons in which intercellular canals, either vertical (V) or radial (R) or both (very rarely together), have been found in the secondary wood is given below. The arrangement is alphabetical and the numbers indicate the natural order according to the classification of Engler and Gilg (1912). The seven families marked with an asterisk (*) were not included in the former paper. (Journ. For., 16:4: 428-441.)

LIST OF FAMILIES

10. Anacardiaceæ (R and V)
19. Araliaceæ (R)
13. Bombacaceæ (V)
22. Borraginaceæ (V)

12 *Malvaceæ (V)
8. Meliaceæ (V)
1. *Moringaceæ (V)
18. Myrtaceæ (V and R)

7. Burseraceæ (R? and V)
17. Combretaceæ (V)
23. Compositæ (R and V)
20. *Cornaceæ (V)
15. Dipterocarpaceæ (V)
2. Hamamelidaceæ (V and R)
4. Leguminosæ (V and R?)
16. *Lythraceæ (R)
3. Rosaceæ (V and R)
5. Rutaceæ (V)
11. *Sapindaceæ (V)
6. Simarubaceæ (V)
14. *Stercnleaceæ (V and R?)
21. Styraceæ (V and R)
9. *Vochysiaceæ (V)

The presence of canals in a wood has in many instances been of great service to the writer in matters of identification. The origin and development of these canals, their relationship to the resin ducts in coniferous woods and their possible phylogenetic significance should be made subjects of special investigation.

LITERATURE CITED

1. Guignard, L.: Les *Daniellia* et leur appareil sécréteur. Journal de Botanique, 16:3:69 (1902).
2. Solereder, Hans: Systematic anatomy of the dictotyledons. Oxford: Clarendon Press, 1908.
3. Trécul, A.: Des vaisseaux propres dans les Térébenthinées. Ann. Sci. Nat., Bot., 7:112-121 (1867).
4. Tschirch, A.: Die Harze und die Harzbehälter. Leipzig, 1906.
5. Svendsen, Carl.: Ueber den Harzfluss bie den Dicotylen, speciell bei *Styrax, Canarium, Shorea, Toluifera,* und *Liquidambar.* Dissertation. Bern, 1905.
6. Moeller, Jos.: Ueber Liquidambar und Storax. Zeitschr. d. allgem. österr, Apoth.-Ver. 34, 1896.
7. Guignard, L.: L'appareil sécréteur des *Copaifera.* Bull. Soc. Bot. France, 39:233-260 (1892).
8. Mezger, —: Beitrag zur anatomischen und chemischen Kenntniss des Holzes des *Eperua falcata.* Arch. der Pharm., 3e serie. 22:873.
9. Trecul, A.: Rapports des vaisseaux du latex le système fibrovasculaire. Ouvertures entre les laticifères et les fibres ligneuses ou les vaisseaux. Comtes Rendus, 60:78-82 (1865).
10. Van Tieghem, Ph.: Canaux sécréteur dans les Dipterocarpées. Jour. de Bot., 1891, pp. 377-385.
11. Guérin, Ch.: Appareil sécréteur dans Dipterocarpées. Comptes Rendus, 140:520-522 (1905); 142:102-104 (1906).
12. Schneider, E. E.: Commercial woods of the Philippines: Their preparation and uses. Bul. No. 14, Phil. Bu. For., Manila, 1916.
13. Brown, F. B. H.: Hawaiian woods. Unpublished thesis, Yale University, 1918.
14. Viguier, Rene: Recherches anatomiques sur la classification des Araliacées. Ann. Sc. Nat., Bot., 9e serie. 4:1-210.
15. Höhnel, Franz v.: Beiträge zur Pflanzenanatomie und Physiologie. IV. Ueber gefässführende Hölzer mit Harzgängen. Botanische Zeitung, 40:10:166 (1882).
16. Moll, J. W., and H. H. Janssonius: Mikrographie des Holzes der auf Java vorkommenden Baumarten. Vols. I-II, Leiden, 1908; III, Leiden, 1918.
17. Jones, W. S.: Pathological secretory cavities in wood. Quarterly Journal of Forestry. 4:2:106-113 (April, 1910).

18. Dixon, Henry H.: Mahogany, and the recognition of some of the different kinds by their microscopic characteristics. Sci. Proc. Royal Dublin Soc., 15 (n. s.); 34:431-486 (Dec., 1918).

19. Boulger, G. S.: Wood. London: Edward Arnold, 1908.

20. Jeffrey, Edward C.: A fossil Sequoia. Botanical Gazette, 38:5:321-332, (Nov., 1904).

21. Von Höhnel, Dr. Franz Ritt.: Ueber stockwerkartig aufgebaute Holzkörper. Sitzb. d. math.-naturw. Classe d. k. Akademie d. Wissenschaften. 89:1:42 (1884).

22. Newcombe, Frederick C.: The cause and conditions of lysigenous cavity-formation. Annals of Botany, 8:32:403-421 (1894).

23. Unwin, A. Harold: West African forests and forestry. New York: E. P. Dutton & Co., 1920.

24. Somerville, William: Abnormal wood in conifers. Quarterly Journal of Forestry, 10:2:132-136 (1916).

25. Kirsch, Simon: The origin and development of resin canals in the Coniferæ . . . Trans. Royal Society of Canada, 5:4:43-109 (1911).

26. Baker, Richard T.: The hardwoods of Australia and their economics. Tech. Ed. Series, No. 23, Tech. Museum. N. S. W., Sydney, 1919.

27. Gerry, Eloise: American storax production: Results of different methods of tapping red gum trees. Journal of Forestry, 19:1:15-24 (Jan. 1921).

A PLEA FOR RECOGNITION OF ARTIFICIAL WORKS IN FOREST EROSION CONTROL POLICY

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One of the most curious fallacies that has so far found lodgment in our National Forest policy is the assumption that because the lack of range control caused erosion, the inauguration of range control would cause erosion to cease. This assumption is, of course, true in a negative sense, in that erosion would have become much worse had not a system of range control been put into effect. It is nevertheless a fact, at least in the Southwest, that in spite of range control, erosion continues on a serious scale. The truth of the matter is that (1) any system of grazing, no matter how conservative, induces erosion, (2) no system of range control, no matter how conservative, can be relied upon to stop erosion already started, and that (3) erosion can be controlled only by a proper system of grazing control, *supplemented by artificial erosion control works.*

The fallacy consists in the failure to recognize the necessity for artificial control works. I do not mean to say that there has been any official pronouncement, explicitly committing the Forest Service to the opinion that such works are unnecessary. I do mean to say that there has been a widespread assumption among foresters that such works are unnecessary and impracticable. I have even heard it said, by experts on watershed problems, that *to admit the necessity of artificial control works would be admitting the failure of our range control system.* I take strong exception to any such viewpoint. Our function is not to prove the infallibility of our initial forest policies, but to conserve the Forests.

I have stated that any system of grazing, no matter how conservative, induces erosion. The proof of this statement can not be set down in print, but may be seen almost anywhere in the hills. Grazing means concentration of stock at ranch headquarters, watering places, salt grounds, driveways, shearing pens, roundup grounds, bed grounds, sunny sheltered spots on south hillsides, and cool breezy spots under shade. All of these concentrations mean some degree of trampling

and the starting of trails along drainage lines. It is impossible to graze stock at all without causing these trampled spots and trails, and any trampled spot or trail may start local erosion. Any local erosion may spread, even through the most well preserved ground cover. Thousands of these incipient erosion spots exist on even the best regulated range. The stage is now set for a cloudburst. In the course of years, the cloudburst is bound to come. When it comes, the deeper soils begin to gully and the creek bottoms begin to go out. When the gullying and loss of bottom lands once starts, no system of range control, unaided by artificial works, can possibly check the process.

There is, moreover, a question whether it is sound business to prevent erosion by conservative range control alone. A typical section of Forest land may carry 10 head of cattle safely without any appreciable starting of erosion foci, 20 head safely if foci are controlled by artificial works, or 25 head when stocked to the full capacity of the forage without regard to erosion. Might not the additional carrying capacity pay for the artificial erosion control, to the benefit of both the land and the public? It appears to be a fact, especially on browse range, that "the forage will carry more stock than the land." Where this is the case it is plain business sense to build up the resistance of the land to full capacity of the forage, if this can be done at a practicable cost. We have certainly never proved that it can not.

CREEK VALLEY EROSION

The loss of creek bottoms is accelerated by the fact that they are the natural sites for ranch headquarters. The timber is cleared for agriculture, all but the most unpalatable shrubs and grasses tend to be eaten out by stock coming in to the ranches for salt and water, and by poor stock too weak to climb back into the hills. Roads and trails are also started paralleling the creek, and when worn out or starting to wash, a new road or trail is started paralleling the old one. When the silt-laden flood comes, the bottom starts to go. A dozen floods, and it is gone. The ranchman accepts his losses as an act of God. But foresters should not and need not so accept them.

The loss of a creek bottom is generally the loss of a key resource, on which all other forest industries depend for their prosperity. These limited areas of agricultural land are necessary to raise hay and grain for saddle stock to handle the Forest range, and for work stock to work the mills and mines. They are also necessary to raise hay, grain, and silage for milk cows for the ranchman's family, and for carrying weak range animals through adverse seasons. They are necessary to

raise orchards, gardens, and poultry. They are are necessary to provide cheap routes for good roads. In short, these creek bottoms, by and large, are the key not only to the prosperity of Forest industries, but to decent social conditions and the building up of Forest homes. The fact that these creek bottom lands are passed into private ownership does not make their conservation the less a Forest problem.

The seriousness and inter-relation of the foregoing conditions is, of course, self-evident to all thinking conservationists. The practical question is: to what extent do these conditions exist, and what can be done to remedy them?

I can not answer this question except for the Southwestern Forests. The following tabulation lists only the more important valleys which have or had extensive ranch communities within the present Forests, and their present condition with respect to erosion:

Forest	Valley	State of erosion
Apache	Blue River	Ruined
	Eagle Creek	Started
	Little Colorado	None
	Nutrioso	Slight
	Bush Valley	Slight
Carson	Tusas	Started
	Vallecitos	Slight
Coconino	Oak Creek	Slight
Coronado	None on Forest	
Crook	Pinal	Slight
Datil	Luna Valley	Started
	Apache Creek	Started
	Tularosa	Started
	Frisco	Partly ruined
Gila	Mimbres	Started
	Gila	Partly ruined
Lincoln	Ruidoso	Slight
Manzano	Tijeras	Partly ruined
	Tajique	None
Prescott	Walnut Creek	Started
	Verde	Started
Santa Fe	Pecos	None
	Rio Las Bacas	Started
Sitgreaves	Showlow Creek	None
	Cottonwood Wash	Partly ruined
Tonto	Tonto Creek	Partly ruined
	Cherry Creek	Partly ruined
Tusayan	None on Forest	

SUMMARY

Valleys	Number	Per cent
Ruined	1	4
Partly ruined	6	24
Started	9	36
Slight	6	24
None	3	12
	25	100

The interpretation of these figures admittedly involves certain questions of definition, and also certain predictions, based on purely personal observations and judgment, as to how far "started" and "partly ruined" valleys will go if no new control measures are used. It is, however, a matter of common knowledge that most of the erosion in the valleys listed has taken place since the range industry was started, namely, during the last forty years. If forty years of grazing has partly ruined 28 per cent of our valleys, and has started erosion in another 36 per cent, then I consider the figures ample basis for predicting that over half of the creek valleys within the Southwestern Forests will be largely ruined within another twenty years, unless artificial control measures are developed and put into effect.

A brief description of a ruined valley may be of interest to those not personally acquainted with Southwestern conditions. The Blue River drains an area about twenty miles wide by forty miles long in the Apache Forest, Arizona. The head waters rise in the Alpine, Douglas fir, and yellow pine types of the White Mountains and the Blue Range. These timber types have never been very severely overgrazed, even before the creation of the Forest. The lower tributaries are in the oak brush and woodland type, and were heavily grazed before the Forest was created. The entire watershed has been normally stocked since. All the old settlers agree that the bottoms of Blue River were, at the time of settlement in about 1885, stirrup-high in gramma grass and covered with groves of mixed hardwoods and pine. The banks were lined with willows and the river abounded with trout. The valley soon became one succession of cattle ranches. Orchards and alfalfa fields were started at each ranch. The surrounding country was so rough that much concentration of stock naturally occurred, the valley and its tributary valleys were eaten out, and about 1900, fifteen years after settlement, floods began to cut an ever widening channel. In 1906, eight years after the Forest was established, erosion was in full swing. Today Blue River valley is mostly boulders, with a few shelves or original bottom land left high and dry between rocky points. Farming is practically at an end because the land is gone, and because it is nearly impossible to maintain headgates to lead irrigation water upon such land as is left. The population about 1900, as estimated by an old cowman, was 300 people on 45 ranches. The present population is about 95 people on 21 ranches. In other words, erosion has

destroyed about two-thirds of the homes, and part of the remainder have lost their irrigated land. The loss of land still continues.

Forest Ranger Stations are often located along these creek valleys. Nearly every year sees the entire or partial loss of agricultural land at several stations on the Southwestern Forests. The fact that the Service is directly a party to these losses makes it seem obvious that remedial measures should be tested, developed, and demonstrated on Ranger Stations wherever possible. Then, if the remedial measures are successful, a little community leadership will soon cause them to be adopted by at least the more progressive neighboring ranchmen. With the high and growing value of ranch property, and the high and rising prices of feeds, the chance for co-operative erosion control work among ranch owners is probably a great deal brighter than most Forest officers realize, and in the absence of special appropriations, is probably the one practicable method of getting the work done.

The technique of creek valley erosion control can not be discussed here, because no technique has been developed. This paper is principally a plea for recognition of the need for a technique. It may not come amiss, however, to suggest briefly some of the methods, plans, and ideas now adopted for testing out in the Southwestern District.

The basis of all technique, considering the vast proportions of the creek valley erosion problem and the lack of funds for expensive construction works, must be some plant or plants which will hold banks. Actual engineering works are financially out of the question at present, except as temporary protection to enable the plants to get started. The plants adopted must be susceptible of cheap propagation from cuttings, must stand some drouth, make rapid growth, make a good mat of roots both above and below water table, and should be *unpalatable to stock.* The various bush willows answer all these requirements except the last. Bush willows are being used and will doubtless be successful on fenced lands where grazing is under control, or on unfenced lands where there is no particular concentration of stock. Tamarisk also holds out some promise. Some plant with all the qualities of bush willow, but with thorns or some other protection against heavy grazing, still awaits discovery. Planting banks is of course of little avail where a valley is already mostly gone. But, for that matter, no other method can reclaim valleys already ruined, except at prohibitive expense.

Check dams will probably not enter into creek valley technique. Wing dams or jetties will, but instead of solid wings the present ten-

dency seems to be toward the angle iron and wire entanglement type, for which ordinary treetops, anchored to the banks by cable, would seem to be a cheap and satisfactory substitute.

Another fundamental point of technique is that there must be some sort of working plan for the creek as a whole. This plan need not be complicated. It should consist merely in charting an ample flood channel, as straight as practicable, and adjusted to such fixed points as rock outcrops, bridges, headgates, existing willow banks, banks protected by heavy timber, masses of driftwood, or other existing barriers. Having mapped out the flood channel, the work of each landowner must be correlated thereto. Uncorrelated work too often merely pushes the trouble down the creek. As an example of costs, the plan for demonstration work on about half a mile of channel on the Walnut Creek Ranger Station, Prescott National Forest, Arizona, calls for two wagon loads of 18-inch willow cuttings, fifty pounds TNT, one-fourth mile of old barbed wire, one team two days for placing driftwood logs and treetops, and about a week of the ranger's time. It will be seen that the cash cost is not heavy. Of course, it remains to be seen whether the work will be successful. If it proves successful, the neighboring ranchmen, who have recently sustained heavy losses of orchards and alfalfa, are already committed to extending the work to their lands, under the ranger's supervision.

UPLAND EROSION

Erosion elsewhere than creek valleys is largely a problem of gullies, although wind erosion is serious in certain dry-farming communities. Upland erosion is more extensive in point of area affected but seems less severe in threatened economic loss, than the creek valley problem.

It has heretofore been almost dogma that well-sodded or well-timbered land would not gully. As to timber, this is generally true in the Southwest. As to sodded open land, it is often not true. Given the foci of stock trails or trampled spots, and gullies are liable to run through any deep soil in the Southwest, no matter how luxuriant the sod. It is true that accidental removal of foci often causes gullies to resod. But this is no solution. Erosion foci are bound to exist so long as the range is used. Therefore artificial works are necessary to prevent the spread of gullies.

Brush and rock dams are undoubtedly the solution of the gully problem. But we know nothing about where and how to build such dams or

how much they cost. Here again a technique must be developed. The inter-relations of slope, soil texture, relation of height of dam to depth of gully, strategic placement in gully, dam intervals, dam materials, placement of materials, and costs must all be worked out and demonstrated by the Forest Service. After this has been done, and if in the meanwhile we have worked out a system of fenced grazing allotments and better security of range tenure, we can doubtless get the co-operation of many grazing permittees in gully control work on their allotments. A few test dams recently built on the Manzano National Forest, from materials at hand on the gully banks, indicate a cost of about one-third cent per square foot for horizontal cedar and rock mat work, and about one cent per square foot of vertical face for cedar and rock dams.

CONCLUSION

For the sake of brevity, some general statements have been made in the foregoing arguments which would not hold water for all the Southwestern Forests without being qualified. To insert all of these qualifications would tire the reader and obscure the issue. Accordingly they have been omitted.

While no artificial control work of any consequence has been done on the Southwestern Forests, no discussion of the subject would be complete without mentioning the admirable results achieved by Munns in California, Maddox in Tennessee, and probably others elsewhere. Investigations have been conducted in the Southwest, principally to determine causes, but causes are well enough known—he who runs may read. Some study has also been given to the differentiation of normal and abnormal erosion. This seems a question of academic rather than practical interest. If erosion is taking away land heretofore untouched, at a rate which will destroy that land within a generation, and if that erosion looks in any degree preventable, the first step is to prevent, not classify.

Parts of the foregoing arguments might be construed as an arraignment of past policies. They are not intended as such, but rather as a plea for extending those policies, for making at least an attempt to supplement our absolutely necessary range control and fire control by equally necessary artificial works. In case this argument for such artificial works proves unsound or impracticable, it may at least invite discussion of what other means we can use to discharge our responsibility for erosion control on the Forests.

LARCH (VENICE) TURPENTINE FROM WESTERN LARCH (*LARIX OCCIDENTALIS*)

By S. A. Mahood,

Chemist in Forest Products

The oleoresin from larch trees was known to Europeans at an early date. Pliny describes it as a honey-like resin that issues slowly from the larch tree but never becomes dry. It was first used by artists in the preparation of their colors and also as a finish on paintings to bring out the colors and to protect them from dust and dirt. It is still used in the manufacture of artists' colors, but is now employed more extensively in making varnishes, sealing wax, fly paper, patent leather, porous plasters, and certain paints and pharmaceutical preparations. The name "Venice" or "Venetian turpentine" came into use because the oleoresin was formerly exported exclusively from Venice.

The oleoresin is obtained from bore-holes made in the trunk of the European larch (*Larix decidua* Mill; *L. europae* De Candolle), which is grown for resin-producing purposes in the Tyrol in Piedmont, and in France in the vicinity of Briancon. The method of tapping [1] is based on the fact that the resin tends to collect in the heart of the tree [2] and often fills the cavities made in the trunk by frost. Early in the spring one or two holes, 2.5 to 3.8 cm. in diameter and horizontal or nearly so, extending to the center of the tree and placed about 30 cm. from the ground, are bored with an auger in mature trees about 100 cm. in girth. The holes are carefully cleaned and then closed with a dry larch plug to prevent loss by evaporation. In the autumn the cavities are emptied by means of an iron scraper. After the second or third collection the holes are widened to 4 cm. In some sections the holes are not plugged, but wooden tubes are inserted in the openings and the resin is allowed to flow through them into suitable receptacles.[3] The yield averages about 200 gm. per tap, and the product

[1] "Die österreichischen Alpenländer und ihre Foreste," p. 369; Archiv der Pharmacie (1900), p. 289.

[2] Botanische Zeitung vol. 17, pp. 329 and 377.

[3] Duhamel. "Traité des arbres" vol. ii p. 355.

obtained is almost pure. The trunk of the tree is but little injured by the tapping, and production, once it is begun, entails but little labor. The same cavities, it is said, yield resin for twenty [4] to fifty [5] years.

Because of its greater value Venice turpentine has been more carefully investigated than have the other varieties of turpentine. The oleoresin was first examined by Berzelius,[6] and others [7] have since investigated it. The most comprehensive study is that by Tschirch and Weigel,[8] who showed it to contain 20 to 22 per cent of volatile oil, composed mostly of pinene with some higher boiling sesquiterpene, and 75 to 80 per cent of resin, composed of laricinole acid, α and β larinolic acids (possibly identical), and indifferent resinous residue. Rabak [9] examined the oleoresin from *L. decidua* (europae) grown in Wisconsin.

More attention has been given, however, to the physical and chemical constants than to the chemical constituents of the oleoresin, since these are the values by which the quality of the product for commercial purposes is determined. For the sake of comparison, values obtained by various investigators are given later in this paper.

For the years 1911 to 1914, inclusive, the average annual importation of Venetian turpentine amounted to 92,026 pounds, but on account of conditions in Europe, importation practically ceased in 1916. Experiments were, therefore, begun by the Forest Service in the spring of 1917 to determine what the possibilities were of obtaining a similar product from western larch (*L. occidentalis*), which occurs in large stands in the Northwest. Holes were made in trees and plugged, as described above, except that they were bored "breast-high." On three areas on the National Forests in Montana trees were tapped between May 22 and June 12, and collections of the oleoresin were made between October 15 and November 15. Single taps were made on thirty trees on each area and double taps on twenty. The trees with double taps yielded on the average nearly three times as much oleoresin as did those with single taps. Table 1, compiled from the reports of the

[4] Tschirch, "Die Harze und die Harzbehälter" (1906), p. 614.

[5] G. Planchon et E. Collin, "Les drogues simples d' origine vegetale, vol. 1, p. 70.

[6] Lehrrbuch der Chemie, vol. vii (1838), p. 42.

[7] Tschirch, "Die Harze und die Harzbehälter" (1906), p. 614.

[8] Archiv der Pharmacie (1900), p. 387; Proceedings of the American Pharmaceutical Association, vol. 49 (1901), p. 744.

[9] Pharmaceutical Review, vol. 23 (1905), p. 44.

District Office of the Forest Service,[10] gives the results obtained on the different experimental areas for the years 1917 and 1918.

TABLE 1.

Locality	Number of trees		Number of taps		Number of productive taps[a]		Approximate yields: Total, ounces		Av. per tap, ounces		Av. for productive taps, ounces	
	1917	1918	1917	1918	1917	1918	1917	1918	1917	1918	1917	1918
Blackfeet National Forest, Fortine Dist.	50	50	70	65[b]	15	36	34	43.5	.5	.7	2.3	1.2
Flathead National Forest, Essex Dist..	50	50	70	66[c]	45	52	164	71.0	2.3	1.1	3.6	1.4
Missoula National Forest, Seeley Lake District	50	50	70	70	17	23	35	34.0	.5	.5	2.0	1.5
Totals and Average..	150	150	210	201	77	111	77.7	49.5	1.1	.8	2.6	1.4

[a] Taps yielding only a trace of gum not counted.
[b] Five plugs had worked out during the winter from trees with double taps.
[c] Four plugs had worked out or were broken and not replaced.

Although the results are disappointing in that the yields are smaller than it was hoped they would be, it is possible that, by boring the holes nearer the ground, selecting the most favorably located stands, and continuing the observations over a longer period, the yield of oleoresin could be materially increased. Further experiments along these lines are contemplated.

EXAMINATION OF THE OLEORESIN

The material sent to the Laboratory consisted of two distinct products, one a thin liquid and the other a thick gum. The former product, a mobile, light brown, opaque liquid, is apparently the sap of the tree. It has a specific gravity of 1.110 at 20° C. and was shown to contain 22.1 per cent of ε-galactan.[11] When oxidized with nitric acid the galactan gave crystals that melted at 212°. Pure music acid melts at 215°. The oleoresin has the consistency of honey, is light amber in color, and is somewhat cloudy because of the presence of

[10] The field work was conducted and the reports were compiled by C. N. Whitney, Forest Examiner, assisted by the Forest Rangers on the different forests. The reports, which are on file in the library of the Forest Products Laboratory, give complete data regarding the climatic conditions, soil, and topography of the different experimental areas, with detailed information regarding the individual trees tapped.

[11] Journal of Industrial and Engineering Chemistry, vol. 8, p. 494.

water and small amounts of suspended material; it has a slightly bitter taste and an agreeable terebinthic odor. The sample from the Fortine district had a somewhat darker color than the samples for the other two areas.

The methods employed in the examination of the oleoresin are those given in Forest Service Bulletin No. 119,[12] except that the specific gravity of the oleoresin was determined by means of a pycnometer. Table 2 gives the physical constants determined and the results of steam distillation after the material was strained through cheesecloth to remove chips.

TABLE 2.

Sample number	Source	Specific gravity 15°	Optical rotation[a] $[\alpha]^{22°}_{D}$	Volatile oil per cent	Resin per cent	Moisture per cent	Trash per cent
1	Blackfeet National Forest, Fortine District	1.0084	—26.02	15.2	81.2	3.3	0.3
2	Flathead National Forest, Essex District	1.0031	—23.71	15.9	81.3	2.7	0.1
3	Missoula National Forest, Seeley Lake District	1.0048	—24.50	16.2	81.2	2.4	0.2
Average		1.0054	—24.78	15.8	81.2	2.8	0.2

[a] 20 per cent alcoholic solution.

Chemical constants on the same three samples were obtained as follows:

TABLE 3.

Sample number	Acid number	Saponification number	Ester number
1	93.1	99.4	6.3
2	88.9	95.9	7.0
3	91.7	97.5	5.8
Average	90.2	97.6	6.4

[12] "An Examination of the Oleoresins of Some Western Pines," by A. W. Schorger.

VOLATILE OIL

The oil obtained by steam distillation gave the following constants, which were found to be unchanged after the oils had stood for a year in amber-colored bottles:

TABLE 4.

Sample number	Optical rotation $[\alpha]^{20°}_{D}$	Specific gravity[a] 20° C.	Index of refraction $[n]^{20°}_{D}$
1	—16.75	.8610	1.4650
2	— 9.84	.8615	1.4665
3	—13.16	.8610	1.4670

[a] Westphal balance.

The three samples of oil were mixed and subjected to distillation over sodium using a 12-inch Hempel column filled with glass beads. Several fractionations gave the results recorded below:

TABLE 5.

Fraction	Temperature ° C. (corrected)	Distillate		Specific gravity, 15° C.	Index refraction $[n]^{20°}_{D}$	Optical rotation $[\alpha]^{20°}_{D}$
		Observed per cent	Cumulative per cent			
1	154.4—155.4	12.0	12.0	.8620	1.4658	—22.61
2	155.4—156.4	45.1	57.1	.8625	1.4659	—21.60
3	156.4—158.1	8.4	65.5	.8632	1.4669	—19.06
4	159.4—162.4	13.6	79.1	.8642	1.4685	—12.44
5	165.7—167.1	10.6	89.7	.8663	1.4693	+ 0.20
6	169.5—171.5	8.0	97.7	.8667	1.4723	+ 6.41
7	171.5+	2.3	100.0	....	1.4738	+ 5.18

l-α-Pinene—The constants obtained for fraction 2 indicate this portion of the oil to be nearly pure α-pinene. The nitrosochloride was prepared according to Wallach's method.[13] A mixture of 50 gm. of oil, 50 gm. of glacial acetic acid, and 50 gm. of ethyl nitrite was cooled in a freezing mixture and 15 cc. of concentrated hydrochloric acid was gradually added. The nitrosochloride readily crystallized out and was filtered off and washed thoroughly with alcohol. When dissolved in chloroform and recrystallized by the addition of methyl alcohol to the

[13]Annalen, vol. 245 (1888), p. 251; vol. 253 (1889), p. 251.

solution, the nitrosochloride melted sharply at 103°, showing this terpene to be α-pinene. While the fraction is levogyrate it contains considerable of the inactive variety for highly active α-pinene does not yield a nitrosochloride.[14]

In the fractional distillation of the oil minute quantities of a crystalline material collected on the walls of the fractionating column indicating the presence of camphene. Attempts to obtain a crystalline product from the various fractions by cooling failed. Fraction 4 was, therefore, tested for camphene by the method of Bertram and Walbaum.[15] Seventy-five grams of oil were dissolved in 187.5 gm. of glacial acetic acid and heated for three hours at 50 to 60°. The reaction mixture assumed a reddish color but did not become homogeneous, and the results of the test were negative.

β-*Pinene*—Fraction 5 was tested for β-pinene by oxidation to nopinic acid according to Wallach's directions.[16] Fifty grams of oil were treated with 116 gm. of potassium permanganate in 1½ liters of water to which 25 gm. of sodium hydroxide had been added. The reaction mixture was shaken for twenty minutes during which time the flask became hot. Steam was then passed through the mixture to remove unchanged oil, 30 gm. of which was obtained. After filtering off the manganese dioxide, the filtrate was evaporated to one-third its volume and allowed to cool, when a white flocculent precipitate separated out. The free nopinic acid obtained from this sodium salt melted at 126°, showing β-pinene to be present in the original oil.

α-*Limonene*—Fraction 6 was found to contain limonene. A portion of the oil was diluted with four volumes of glacial acetic acid, the mixture was cooled, and an excess of bromine was gradually added. No crystals appeared immediately, but after a few drops of water were added and the reaction mixture was allowed to stand for several days, the tetrabrom derivative crystallized out. These crystals melted sharply at 104°.

RESIN

The non-volatile residue left after the steam distillation of the oleoresin gave the constants recorded in table 6:

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[14] Journal American Chemical Society, vol. 39 (1917), p. 1040.

[15] Journal für praktische Chemie, vol. 49, part II (1894), p. 1.

[16] Annalen, vol. 356 (1907), p. 228.

TABLE 6.

Sample number	Optical rotation[a] $[\alpha]^{20°}_{D}$	Acid number	Saponification number	Ester number	Specific gravity[b] 20° C.
1	+35.53	112.5	120.4	7.9	1.017
2	+34.42	109.0	123.0	14.0	1.020
3	+34.41	114.3	122.5	8.2	1.018

[a] 10 per cent alcoholic solution.
[b] Salt solution method (Forest Service Bulletin No. 119).

This material had a slightly dark amber color and, after standing for more than a year, still remained plastic, except for a very thin superficial film, which became somewhat hardened. All attempts to obtain a crystalline product from it failed.

The average values obtained by various investigators on larch turpentine and those obtained in the present investigation of material from western larch are given in Table 7. There are also included in the table the values obtained by Schorger [17] for Douglas fir turpentine, which has been called "an excellent substitute" for Venice turpentine by a commercial firm to whom samples were sent by the Laboratory.

TABLE 7.

Species								Larix occidentalis	Pseudotsuga taxifolia
Investigator	Von Schmidt and Erban[a]	Beckerts and Bruche[a]	E. Dieterich[a]	K. Dieterich[a]	Tschirch and Weigel[b]	Rabak[c]	Commercial standard[d]	The author	Schorger[e]
Acid number....	67.7	89.7	70.6	67.9	70.0	60	67-77	90.2	114.9
Saponification number	97.5	91.7	120.6	121.1	141.4	......	99-133	97.6	121.0
Ester number...	29.8	2.0	50.0	53.2	71.4	......	36-56	6.4	6.1
Specific gravity..	......	1.129	......	......	1.185	1.0004	......	1.0054	.991

[a] K. Dieterich, "Analysis of Resins, Balsams, and Gum-Resins" (1901) p. 256.
[b] Tschirch, "Die Harze und die Harzbehälter" (1906), p. 616.
[c] *Loc. cit.* Product from tree grown in Wisconsin.
[d] New York importing firm.
[e] Journal of the American Chemical Society, vol. 39 (1917). p. 1040.

[17] Journal of the American Chemical Society, vol. 39 (1917), p. 1040.

Table 8 gives a comparison of the solubilities of the oleoresins of the two species of larch. Complete solubility in glacial acetic acid is indicative of larch turpentine. In this solvent the product from western larch is soluble only to the extent of about 96 to 97 per cent.

TABLE 8.

Solubility in—	Oleoresin from—		
	Larix decidua[b]	Larix decidua[a]	Larix occidentalis
Ethyl alcohol (95%)	Complete[a]	Complete[b]	Complete
Ether	Complete	Almost complete	Complete
Methyl alcohol	Complete	....	Complete
Acetone	Complete	....	Complete
Oil of turpentine	Complete	Complete	Complete
Benzine	Complete	Complete	Partial
Chloroform	Complete	Complete	Partial
Carbon disulphide	Partial	Almost complete	Partial
Glacial acetic acid	Complete	Complete	96 to 97%
Petroleum ether	Almost complete	98.89 to 100%	Partial

[a] Von Schmidt and Erban.
[b] E. Dieterich.

Unlike that from *L. decidua*[18] the oleoresin from *L. occidentalis* does not dissolve completely in three parts of 80 per cent alcohol, nor does its alcoholic solution remain clear when made alkaline with 10 per cent potassium hydroxide. On the other hand, both oleoresins possess a slight greenish fluorescence in reflected light, and neither solidifies with one-sixteenth its weight of magnesium oxide.

SUMMARY

The oleoresin from *L. occidentalis* contains approximately 16 per cent of a volatile oil consisting chiefly of α-pinene together with smaller amounts of β-pinene and α-limonene. The non-volatile portion is a resin possessing acid properties but yielding no crystal-line product by the usual methods of crystallization.

The oleoresin does not conform to some of the accepted test for Venice turpentine. The acid value, for example, is high, and the ester value low, as compared with the commercial standard. However, the values agree very well with the results obtained by Beckerts and Brüche

[18] See National Formulary IV.

and more nearly approach the values for the oleoresin from *L. decidua* than do the results obtained by Schorger on Douglas fir turpentine (Oregon fir balsam).

Two properties make Venice turpentine of value for particular purposes: it does not readily become hard on exposure; and, after standing, crystals do not form in it. The oleoresin from western larch possesses these properties, and tests made by a commercial firm indicate that western larch turpentine is a satisfactory material for all those industrial purposes for which Venice turpentine is ordinarily used.

DESTRUCTION OF MICE IN THE FOREST BY THE LOFFLER RAT-TYPHUS BACILLUS[1]

By Dr. Gerhardt, Coblenz

(Translated by E. C. Rogers)

The beech nut crop of 1909-10 was not very abundant, has suffered further considerable loss through many animals. Wild pigeons and mice appeared in great numbers and were most injurious. Particularly in the seeding places, in which soil-preparation by machinery or hoeing took place, the beechnuts disappeared rapidly. The loss was the more noticeable where artificial sowing was done with purchased seed.

After the beginning of February, wherever an uncommonly strong appearance of mice had been noted, I brought into use in 11 guard districts on an area of 170 hectares the rat typhus cultures. These were procured from the Bacteriological Institute of the Agricultural Chamber at Borme, and were laid out according to plans locally agreed upon with the head of the division, Dr. Krantstrunk. Such guards as were not present at this oral instruction, were later informed as to the use and procedure with the cultures by the officer from the institute who delivered them.

For 483 marks there were obtained sufficient cultures in glass test tubes for use. An average of 7.3 tubes were used per hectare. Consequently, each hectare cost 2.83 marks for the means of destruction. The cost of laying out, including the buying of the necessary white bread, amounted altogether to 485.71 marks, consequently 2.85 marks per hectare. An average of 0.62 mark for bread was necessary per hectare. The laying out places were from 0.4 to 1 square meter in size. There were about 400 of these per hectare. After removal of the weed cover a square meter spot showed from 1 to 4, on an average of possibly 2 mouse holes. On each spot was placed a handful of the bread crumbs infected according to instructions, which was then covered by replacing the leaves. These spots remained visible for days through the disturbed appearance of the leaves. After several days the crumbs everywhere had almost completely disappeared, and had

[1] Allgem., F. J. Z. 87 (1911) :37.

doubtless been taken by mice. The guards and forest laborers began soon to find here and there dead mice and often sick ones. The disease was manifested by thickly swollen belly and slow, feeble movements. After infection by far the greater proportion of the mice naturally died in their hiding places.

In order to determine whether the agent had helped radically, some 14 days after the use of the typhus cultures in one district in which bread crumbs had been laid out on 75 hectares and where the mice had appeared especially numerous, I scattered wheat in many places. The latter was never disturbed. On this account I consider justified the assumption, with which the district guards agree, that the effect of the agent has been very good and thorough, and I am convinced that without its use almost none of the beech seed would have remained. Upon the basis of my experience I might recommend in further instances of use that the cultures be, above all, laid out timely, i.e., at the beginning of winter. Indeed, it is a well-known phenomenon that beech seed years as a rule coincide with mouse years, and on this account forest guards should, in my opinion, in the fall of the year, after removal of the leaves on numerous observation places in the sowing areas, be urged to ascertain the average number of mouse holes per square meters in order thereby to furnish a safe standard for the extent of the appearance of the pest. With a very heavy seed crop, naturally, less consideration need be paid to the destruction than with a very sparse seed crop, which (contrary to the common principle that "quarter-mast" is not to be used) is in many cases indispensible for the regeneration, particularly in smaller communal forests and regions with infrequent beech seed crops.

In conclusion it may still be noted that the use of typhus cultures has also taken place with excellent success here, for the destruction of mice in the forest nursery. The contents of a few tubes, laid around for short periods, was sufficient to keep a nursery completely mouse free.

HAS THE AMERICAN FORESTRY ASSOCIATION LOST ITS FORMER USEFULNESS?

REFLECTIONS OF A DIRECTOR

By Professor Herman H. Chapman

Yale University

PART I—POLICIES

When the American Forestry Association was formed in 1882 the following statement appeared in its constitution: "The object of this Association is discussion of subjects relating to tree planting, the conservation, management, and renewal of forests and the climatic and other influences that affect their welfare, the advancement of educational, *legislative*, and other means tending to promote these objects."

The Association was formed by men who foresaw the need of legislation and the rôle such an association could play in securing it. It drew within its membership practically all the leaders of forestry, and as professional foresters began to appear as the result of educational training, membership in this Association was regarded as an obvious duty.

Today the Association stands completely discredited in the eyes of the entire body of professional foresters who are acquainted with the facts of its management, and only ignorance of these facts on the part of its members and the public preserves to it a shred of its former influence and usefulness.

The causes which have wrought the ruin of this great Association are of vital interest to Americans and especially to foresters, who by their training and duties are the leaders of public thought in forestry in this country and will remain so.

The elements in the problem are: the organization of the Association, its policy, its magazine, and its finances. The last three factors are inevitably determined by the first. Upon the men selected to direct the Association and their success depends that of the Association itself. For the membership is powerless to accomplish these results under inefficient or untrue leadership.

In January, 1891, the Association declared, "Since much of the destruction of the forest resources of the country can be traced to defective legislation, both State and National, this Association will

endeavor to use its influence toward enactment and enforcement of better laws."

In 1900 Edwin A. Bowers, then its Secretary, said, "The present National reservation system (National Forests) is the work of this Association."

In 1911, largely through its President, Curtis Guild, and its activities, the final passage of the Weeks law for land purchases by the National Government was achieved.

On January 18, 1915, Henry S. Drinker, then President of the Association, in a public lecture delivered before the Engineering Section of the student body of the University of Illinois, in his rôle as President of the American Forestry Association, said:

"And let us give recognition to the thought that conservation may be overdone by the undue and unwise stimulation of such popular demand for drastic control that we may dwarf the business development of our present and coming generations by conserving resources now urgently needed, only to set them aside for the needs of an indifferent future when other agencies may have been found to take their place. Do not be blinded or misled by the fears of the uninformed, or by what is equally dangerous, the narrow view of the partially informed, who fear industrial dangers they have never actually faced, and preach a crusade against evils that are so theoretical that practical men know them to be imaginary.

"Today there is a serious difference of opinion as above noted, in these matters between the East and the West, or rather between those particularly in sympathy with or supporting the National control of reserved lands in the West on the one hand, and governing authorities and citizens on the other hand, of some of the Western States. Our western brethren urge that their several States should have as States the same control over their woods, mines, and waters as the Eastern States enjoy.

"*It is not the part of the American Forestry Association to take part in this contention.* It is the duty of this body to teach and to urge the economic use and conservation of our natural resources whether they are located in Government, State, or private holdings, *and not to become involved as partisans in any position of antagonism in political discussions of this nature.*"

On February 10, Dr. Drinker addressed a formal communication to the Board of Directors of the American Forestry Association stating:

"Government ownership of land in the Western States raises a very serious question of policy and finance, and it is idle to say or argue that the opposition to it throughout the West is negligible or futile.

Decidedly I urge upon you that it is not—decidedly not—the function of the American Forestry Association to take sides in this matter. Our Association exists to teach conservation in forestry and forestry lore throughout the country—not to be drawn into or take sides in a question of this kind likely, from the immense importance to the Western States, to be fought out with vigor, leaving our Association, should we follow Mr. Graves' wish, *in the position of a discredited and beaten ally of the Forest Service* if the western contention should prevail. We should be tail to no Bureau's kite, but a great independent organization leading forestry, applauding and supporting its scientific practice whether in National Forests or in State, commercial, or private reserves. I have constantly made it my duty in addresses on conservation and forestry throughout the country to pay tribute to the splendid work of the Forest Service and to Mr. Graves personally, but as soon as we become known simply as an adjunct of a Government Bureau we shall have as little influence or credit as for instance the National Conservation Association."

This statement and position were not shared by the directors, twelve of whom finally expressed themselves as supporting the National Forest policy. Dr. Drinker's efforts to prevent the Association from reiterating its stand on the National Forests continued unremittingly [1] until in January, 1916, he failed of re-election to the presidency and the plank was adopted which reads: "It will support National and State forests under Federal and State ownership, administration, and management."

This public attitude of its President, who held office for three years in 1913, 1914, and 1915, first undermined the confidence of the foresters in the Association and an open denunciation was avoided only by the actions taken as recorded above.

With the election of Charles Lathrop Pack at Boston in January, 1916, it looked as if this condition would be removed. The ghastly fiasco of the Sixth Conservation Congress, which sounded the death knell of that organization, was pulled off in May of that year at Washington with Dr. Drinker as chairman of the resolutions committee. On page 353 of the July issue Mr. Pack printed a statement upholding the National Forest policy, and on page 430 of the August issue he reiterated this support.

But during the years which followed, 1917, 1918, and 1919, this advantage was again completely dissipated, to such an extent that the dissatisfaction with these conditions led to an effort to elect new officers and directors at the annual meeting in New York in January,

[1] See page 1055, *American Forestry*, November, 1915.

1920, an effort which was unsuccessful. Following this attempt, those then in control of the Association decided to prevent all possibility of its repetition by providing a self-perpetuating board of fifteen directors, which, under protest, was modified to seven, with eight elected by the members. This proposition was put through at the last meeting.

The developments of these last four years are incomprehensible without a knowledge of the other elements which entered into the internal situation of the Association. The foresters abandoned or condemned it for just one thing, a total breakdown of the policy of the Association, which rendered it useless for the purposes for which it was founded, and the evident fact that under the reorganization, this condition would become permanent. The Association could no longer be relied on to put up a fight for any public measure in which the public interest might be opposed to private interests. How did this come about? The answer is found in the working out of the three other factors, namely, the organization of the Association, its magazine, and its finances.

PART II.—THE ORGANIZATION AND MAGAZINE

The Association was founded as a voluntary organization for the inculcation and spread of a forest policy adequate for our economic needs as a nation; and any person was eligible for membership. Annual meetings were held at which a President, Treasurer, and directors were elected, the number of directors being finally fixed at fifteen. These officers were nominated by a committee, usually of five men selected by the presiding officer, from those present. James Wilson, Secretary of Agriculture, was President from 1899 to 1908, inclusive, at which time Gov. Curtis Guild, Jr., of Massachusetts, was elected and served till his death in 1911. In 1912 Gov. Robert Bass, of New Hampshire, served for one year, to be succeeded by Henry S. Drinker in 1913 and by Charles Lathrop Pack in 1916 to date.

The executive officer of the Association is a Secretary appointed by the Board to serve at its discretion. Upon him devolves in a large measure the success of the Association and its reputation. For a time previous to 1907 the management of the magazine was conducted as a separate private business venture under an editor, but since 1907 the Secretary has been the editor as well as the financial manager of the Association. Management and magazine cannot be separated in tracing the conditions as they now exist.

On January 1, 1895, John Gifford brought out the first number of the *Forester*, a bi-monthly, which on January 1, 1898, the Association took as its official publication. Three years later H. M. Suter, by arrangement with the Association took the magazine, which he then combined as the official organ of the Forestry and of the National Irrigation Associations, changing its name to *Forestry and Irrigation*. The Irrigation Association pulled out of this arrangement in 1904, but the name and arrangement continued until January, 1907, when the Forestry Association took control of the magazine, with Thomas E. Will as Secretary. In January, 1909, Edwin A. Start succeeded Mr. Will as Secretary, a post which he held until August, 1911, when he resigned and in October, 1911, Percival Sheldon Ridsdale was appointed by the Board as Secretary, the position which he now holds.

Under Mr. Will, the magazine again changed its name to *Conservation*, but in 1910 adopted the title *American Forestry*, and the Association adopted the definite policy of sticking to forestry as its main issue. The directors' report stated: "In the sudden development of the conservation movement, this Association was for a time involved in the general haziness as to ultimate objects, and the extent and importance of the work that brought it into being was temporarily lost sight of."

During the period 1907 to 1910, inclusive, when the Association was vacillating as to its policy and purposes, a serious loss of initiative occurred, accompanied by financial difficulties which threatened to end its activities once for all. The gross debt of the Association on January 1, 1911, was approximately $10,000, offset by $6,162 bonds (purchase value). The Secretary seemed powerless to make headway against this condition. A practically new Board of Directors was elected in 1911, through the activity of the nominating committee composed of Philip Ayres, J. W. Toumey, and F. W. Rane.

On this board elected at that time were the names of Governor Bass of New Hampshire, H. H. Chapman, Curtis Guild, Austin Hawes, Chester Lyman, Charles Lathrop Pack (first elected a director in 1910), Charles F. Quincy of New York, and E. A. Sterling.

The foresters, Hawes, Sterling, and Chapman, became immediately active in encouraging Governor Guild to stay by the sinking ship. The immediate problem was financial reorganization, without which, it had been demonstrated, the Association could not continue. This involved raising revenue to cancel indebtedness, extending membership, and building up the circulation of the magazine to a point where the income would meet the ordinary expenses of carrying the Association. In this aspect, of making a financial and business success of the enterprise, Charles F. Quincy at once interested himself profoundly and has from that time been heart and soul in the work, which has for him

no selfish or indirect object, but whose interest centers on this phase of the problem to the comparative exclusion of the public duties and policies of the Association. Chester Lyman has remained also as a director, representing the International Paper Co., quiet, conservative an excellent type of careful corporation director, but as with Quincy not fully awake to the public duty and responsibility of the Association or also, of necessity, constrained by his business connections to consider all acts of the Association in the light of their effect on his corporate responsibilities.

The organization of any association centers around the men who will put the time and attention on its affairs, and through Mr. Quincy's willingness to do this and his efforts to raise money, the meetings of the directors came to be held in his office in New York, where Lyman, Sterling, Chapman, and Pack constituted the working nucleus of attendance at board meetings; with Alfred Gaskill for a period covering his directorship, and W. R. Brown of New Hampshire, occasionally in attendance. The problem of running an association consists of getting men so located and so constituted that they will and can attend board meetings. Geographical representation gets nowhere. No director has ever exercised a feather's weight of influence on this Association unless he has attended these meetings. This means that the above-mentioned directors slowly became the Association de facto and it became increasingly difficult to "get new blood" on the board. The Association, under its new Secretary, Ridsdale, was gaining ground financially, its membership was increasing, and it didn't seem wise to swap horses. A change was made in the by-laws by which instead of all fifteen directors being up for election annually, only five would be elected for three-year overlapping terms. When the five whose terms expired would come up for re-election the Association usually put them in again. The old constitutional form with its nominating committee was retained until after Mr. Pack was elected as President in 1916. Effort was made to improve the composition of the board from time to time by dropping dead ones and trying out others. Mr. Greeley became a member after the prejudice against having a Government officer on the board was overcome. The theory was that the board should be composed of foresters, lumbermen, and business men, so that it would be well balanced and serve to further co-operation and progress, representing the general public interests and not that of any class. This sound basic plan broke down completely through the injection of elements not foreseen, which upset the balance of power and delivered the Association root and branch into the hands of mercenary interests. Had certain fundamental principles of healthy board government been adhered to it should have worked out as a success, not merely from a business standpoint, but from that of policy and public confidence as well. For the immediate causes of this failure we must turn to the financial policy.

THE ANNUAL MEETING OF THE AMERICAN FORESTRY ASSOCIATION

The adjourned annual meeting of the American Forestry Association was held in Washington, D. C., on February 25, 1921. After a general statement by the President as to the activities and accomplishments of the Association during the past year, the nomination by the Board of Directors of the following officers was announced:

President, Charles Lathrop Pack.
Treasurer, Charles F. Quincy.
Directors, E. F. Baldwin, N. C. Brown, W. R. Brown, Standish Chard, John Hays Hammond, Addison S. Pratt.

Prof. R. S. Hosmer, of New York, presented from the floor the following nominations which were seconded by Mr. P. P. Wells, of Connecticut:

President, Charles Lathrop Pack.
Treasurer, John E. Jenks.
Directors (to serve three years), Henry S. Graves, John E. Jenks, John B. Burnham, F. H. Newell, Wm. E. Wharton; (to fill unexpired term) F. W. Besley.

A comparison of the lists of directors presented by the Board and by the rank and file of the membership shows the leaning of the two sides.

Mr. Wells demanded the reading of the call for the meeting from which it appeared that the constitution of the Board of Directors was proposed to be revolutionized as to tenure and powers. He supported Professor Hosmer's nominees as opponents of this radical change. His remarks were ruled out of order and he was not permitted to read a letter he had written to the President objecting to the latter's program. These rulings were, on appeal, supported by a majority of those in attendance. The officers and directors proposed by the Board of Directors were thereupon overwhelmingly elected by a standing vote. Obviously the meeting regarded such men as Henry S. Graves and F. H. Newell, who have done so much for the cause of forestry in this country, as undeserving even of serious consideration.

The next business was consideration of amendments to the by-laws proposed by the Board of Directors. The actual wording of the

proposed amendments was not presented to the meeting but the following summary of their provisions was read by the Secretary:

For increasing the subscribing membership dues from $3 to $4 a year.

For a Board of Directors consisting of fifteen members, seven of whom—W. R. Brown, H. H. Chapman, Dr. Henry S. Drinker, C. W. Lyman, Charles Lathrop Pack, C. F. Quincy, and E. A. Sterling—shall be permanent members, and eight others, four being elected annually to serve the terms of two years.

For the nomination by the Board of Directors of elective candidates for the Board and provision for other nominations by members.

For the election of the elective directors by vote of members present at the annual meeting and by the mail vote of those not present.

For the election of the President, Vice Presidents, Treasurer, and Secretary by the Board of Directors.

For the amendment of the by-laws, except as to the selection of permanent directors, either by the Board of Directors or by members.

For annulment of membership of members in arrears in dues for one year.

Immediately following this statement by the Secretary a rather lengthy speech was made by President Pack. After stating that those present would undoubtedly wish to know the reasons for the proposed amendments, he spent considerable time justifying the suggested increase in subscribing membership dues from $3 to $4. Not even a passing reference was made to the radical changes which would be effected by the other proposed amendments, the importance of which may be gauged by the following statement signed by Prof. H. H. Chapman, a Director of the American Forestry Association, which was passed among the audience:

In view of the proposed changes in the by-laws of the Association, to be submitted to the members attending the annual meeting at Washington on February 25, whose action will be binding upon the 16,000 members of the Association, the following facts should be considered. These proposed by-laws, unless revised by the Board after February 21, will provide that

1. Of the fifteen directors, six of whom will be elected at this meeting, seven shall hold office for life, and the remaining eight shall hold office, four for one year and four for two years, and hereafter four shall be elected annually by letter ballot.

2. These letter ballots shall be mailed to the Secretary and later submitted and counted at the annual meeting, together with ballots cast by members in attendance.

3. No provision is made for regular meetings of the Board of Directors, but meetings shall be called by the President, or upon the request of a majority, or eight members, of the Board.

4. An executive committee of seven members of the Board is to be chosen by the President which shall have and exercise all the powers of the Board when the Board is not in session, and can therefore take any action or exercise any powers which nominally rest in the Board.

5. The provision in the present by-laws requiring the publication of the financial statement or Treasurer's report is eliminated.

6. The Board of Directors is given the power of changing the by-laws on all points except those governing elections. The members, at annual meetings can also change these by-laws provided notice of such change is first published in *American Forestry*, but in this case the Board at its next meeting could repeal such changes and substitute their own provisions.

7. The provision in the present by-laws for bonding the Secretary is omitted. The Secretary is, as formerly, elected by the Board annually, with full responsibility for the financial and business conduct of the Association. No specific provision is made by which the Board shall determine his compensation or commissions.

The following additional facts should be noted:

1. The Board reappointed the present Secretary on February 20, 1920, but did not fix his compensation nor authorize any officer, member or committee of the Board to determine it. No previous contract or agreement has been in force during the year 1920 or 1921, therefore the compensation of the Secretary since January 1, 1920, has not been authorized by the Board elected in 1920.

2. A five-year contract between the Secretary and the Board expired on December 31, 1919, by which the Secretary received an annual salary of $5,000, and in addition, received 20 per cent of the gross income of the Association from memberships, subscriptions to the magazine and advertising, excluding life memberships, gifts, bequests and commissions paid to others for advertising, also excluding a reserve of $21,000 from annual income.

3. Although this contract is not in force and the Board has not been given an opportunity for renewing, rejecting or changing its terms or for substituting other arrangements, the Secretary has received from the funds of the Association during the year 1920, the sum of $13,177.17 under the same terms as if the contract were still in force and the Board had sanctioned the arrangement.

4. The officers of the Association regard it as a business whose secrets shall not be imparted to its members, and even the directors are not furnished with copies of the financial statement.

5. The Treasurer of the Association, J. E. Jenks of Washington, D. C., publisher of the Army and Navy Register, who was unanimously re-elected to serve for the year 1920, was prevented from serving by

a ruling obtained by the Secretary from an attorney, to the effect that the by-laws were changed before the election, and required the Treasurer to be a member of the Board. This change was made after the ballots had been cast. Although a vacancy has existed on the Board since March 2, 1920, by the refusal of Director Gaskill of New Jersey to accept election, no move was made to elect the Treasurer to this vacancy and enable him to serve.

In view of these facts the members present should exercise judgment in deciding upon the advisability of entrusting the affairs of the Association to a Board so organized that the members of the Association, as well as a majority of the Board would cease to exercise any effective control over either the finances or the policy of the Association.

HERMAN H. CHAPMAN,
Director, American Forestry Association.

Professor Chapman has since stated that at the meeting of the Board in the morning of the same day that the annual meeting took place, the Board agreed, after a two hours' fight on his part, to modify some of these points. They did not agree, however, to change the provision for seven perpetual directors or the provision by which they should have the power to amend the by-laws. The latter point was not even discussed. Since, however, no attempt was made to explain or reconcile the discrepancies in the summaries by Professor Chapman and the Secretary, and since the amendments themselves were not presented to the meeting, there was no way in which those present could tell exactly what it was they were voting on.

On the conclusion of Mr. Pack's statement, Mr. Wells presented a number of arguments against the adoption of the proposed amendments and read in full a letter to Mr. Pack from Mr. H. A. Reynolds, Secretary of the Massachusetts Forestry Association, also opposing the adoption of the amendments. Mr. Reynolds' letter called particular attention to the fact that the organization proposed gave practically complete control of the Association to the Board of Directors, seven of whom would be permanent members, including authority to elect officers, to nominate the elective members of the Board, and to amend the by-laws. He pointed out that these changes, making possible as they did the control of the Association by special interests for their own purposes, were extremely dangerous and were more than likely to forfeit public support and thus endanger the usefulness of the Association. He therefore urged that no such action should be taken

without a referendum vote by the entire membership. Both Mr. Wells and Mr. Reynolds stressed the fact that the only notice of the meeting had appeared in an inconspicuous place near the end of the February issue of *American Forestry*, in striking contrast to the prominence usually given notices of annual meetings, and it was questioned whether any action taken at the meeting would be legal.

During Mr. Wells' statement some of those in attendance at the meeting, which was composed so largely of young ladies that a newspaper reporter inquired whether the membership of the Association was made up chiefly of high-school girls, started to leave the hall. Mr. Pack, interrupting the speaker, urged them to remain until the close of the meeting, saying significantly that it would last only a few minutes longer. This remark apparently shortened the statement by Mr. Wells, who promptly remarked that he would be through in a minute.

When he concluded, Mr. Pack stated that he noticed that whenever Mr. Reynolds desired money he came to him for it and that he had just recently sent him a check. He gave the impression that Mr. Reynolds' alleged requests for contributions were made on behalf of the Massachusetts Forestry Association and added that the Board of Directors of that Association had no foresters on it.

Mr. Reynolds promptly replied that to his knowledge he had never asked Mr. Pack for any contributions whatever, although he had recently received a check from him transmitted through the Chairman of the National Forest Fire Prevention Committee. He added that when this committee was organized Mr. Pack was asked to become a member of it but declined on the ground that it was duplicating work already handled by the American Forestry Association, whereas in fact the committee was formed precisely because the American Forestry Association was not doing such work. He also pointed out that the Board of Directors of the Massachusetts Forestry Association has always had foresters on it and at present has two foresters, Mr. H. F. Gould and Mr. J. S. Ames. Mr. Pack interrupted that he did not know this, to which Mr. Reynolds replied that he should know before making any such statements. Addressing himself then to the proposed amendments to the by-laws, he reiterated the position taken by him in his letter to Mr. Pack objecting particularly to the appointment of a considerable number of directors to life membership. He stated that he knew of only one association where any considerable number

of the Board of Directors was permanent and that that Association, which at one time had been a most powerful and useful one, had, as a result of that action, lost its influence and was now making no progress whatever. He emphasized his belief that the proposed amendments were altogether too important to be voted upon at a gathering of only about 150 members out of a total of 16,000 and stated that if the amendments were adopted, as he presumed they would be, he would, if permitted by the President, offer a motion to refer the action of this meeting to a referendum vote.

During and following Mr. Reynolds' talk more restiveness made itself manifest in the meeting and others started to leave and were again begged by the President to remain. Mr. Barrington Moore, of New York, in spite of the evident desire to force a vote and get the meeting over with, stated that he wished to point out that the action which it was proposed to take at this meeting was the biggest thing that had yet come before the Association. He emphasized both the radical nature and dangerous character of the proposed amendments. He also stated that the National Information Bureau of New York City, an organization which was composed of prominent and public-spirited men of high standing in the country and of which he was a member, had recently investigated the American Forestry Association and had found that its affairs at present were so conducted that the Bureau, which had been formed to advise investors and contributors as to organizations worthy of their support, would not endorse the Association. He added that if the amendments were adopted the suspicions of the National Information Bureau as to the reliability of the Association would be strengthened, decidedly to the detriment of the Association.

Mr. Wells offered an amendment to the pending motion for the adoption of the proposed amendments, the effect of which was to provide for a referendum vote. Mr. Pack opposed the proposed referendum on the ground that it would cause delay and involve a needless expenditure of some $600 or $700, and that the Association did not have the money. He added, somewhat irrelevantly and patronizingly, that while the foresters were good enough fellows who must be looked to for supplying information they could not handle the publicity. A gentleman in the middle of the hall also opposed Mr. Wells' motion, stating that it was impossible for many members of the Association to attend such a meeting as this or to take part in the

conduct of the Association and that the thing to do was to leave its conduct to a strongly organized Board of Directors. When Mr. Wells' motion failed to carry (24 to 95), Mr. Reynolds promptly offered another amendment also providing for a referendum vote, but in addition providing for the submission of statements for and against the proposed amendments and for a special committee to insure the impartial counting of the votes. Twenty-one rising votes were cast in favor of Reynolds' amendment. The Chairman declared it lost without calling on the negative to vote.

Further signs of restiveness in the audience developed and quite a number of those originally present succeeded in getting away in spite of Mr. Pack's energetic efforts to hold them. There was a very apparent desire on the part of many of those present to wind up the business of the meeting and adjourn as promptly as possible. Prof. H. H. Chapman, of Connecticut, however, insisted in a brief statement on making his protest against the proposed amendments a matter of record. He pointed out their dangerous character and stated that as a member of the Board of Directors of twelve years' standing he was absolutely opposed to their passage and had been opposed to having them presented to the meeting. Mr. Pack then emphasized once more the cost of a referendum ballot, and on the statement from some one in the hall that it was worth it to avoid the charge that the meeting was packed, sneeringly replied that the foresters seemed to be present in considerable numbers but that he would hardly call that packing the meeting.

The final vote on the motion to adopt the amendments was taken almost immediately following Professor Chapman's statement. The result of this vote was announced as 121 for and 25 against the adoption of the amended by-laws. Professor Chapman raised the point of order that the total announced vote considerably exceeded the total number of persons present in the hall. Mr. Pack ignored this point of order and promptly declared the meeting adjourned.

The most salient features of this extraordinary meeting were as follows:

1. It made seven members of the Board of Directors (one less than a majority), who had been nominated by the Board, permanent members.

2. It authorized the Board (*a*) to nominate its own elective members; (*b*) to elect the President, Vice Presidents, Treasurer, and

Secretary; and (*c*) to amend the by-laws except as to the selection of permanent directors.

3. It thus turned virtually complete and permanent control of the Association over to a group of seven persons selected by the Directors.

4. It took this action without even formal presentation of the proposed amendments to the by-laws, without any argument whatever in their support, and in the face of vigorous opposition to them.

5. In spite of the radical nature of the changes to be acted upon by the meeting, the only notice of it appeared in an obscure place in the February issue of *American Forestry*.

6. The meeting itself was composed largely of girls of high-school age and evinced an unmistakable desire to get the business over with and adjourn as promptly as possible.

7. Some of those present admitted rather shamefacedly that they did not quite know what they were there for, but that they had been urged over the telephone to come.

8. The President tried to discourage discussion and went out of his way to make it plain, by insinuation, that he discounted the efforts and accomplishments of foresters and that he regarded them as virtually incompetent to handle such an organization as the American Forestry Association.

9. An important point of order, involving a question of fact that could readily have been established, was ignored by the President who at once, without motion from the house, declared the meeting adjourned.

10. The tenor of the meeting is succinctly summarized in this statement by an old, gray-haired reporter present at the meeting: "In my long experience as a reporter of various conventions, I have witnessed many raw reals put over, but never one so raw as that which was put over this afternoon."

P. P. Wells Protests

March 10, 1921.

To the Editor of The Journal of Forestry.

At the meeting of the American Forestry Association held in Washington on the afternoon of February 25, I attempted to read a letter written by me February 23 to the President of the Association. The letter had been delivered to Mr. Pack that morning. My purpose in reading it at the meeting was to express more briefly than could be

done by extemporaneous remarks my objection to the autocratic revolution embodied in the proposed amendments to the by-laws.

The President of the Association refused to allow my letter to be read, ruled me out of order, and was sustained on appeal.

May I therefore ask you to give to my letter in the JOURNAL the publicity that was denied at the meeting of the American Forestry Association.

Respectfully,
PHILIP P. WELLS.

Middletown, Conn., Feb. 23, 1921.

MR. CHARLES LATHROP PACK, PRESIDENT,
American Forestry Association,
Washington, D. C.

DEAR MR. PACK:

I had hoped to attend the annual meeting of the American Forestry Association in Washington this week but it now seems doubtful whether I shall be able to do so. The proposed changes in the constitution of the Association are so grave in character that I am placing this expression of my opinion in the hands of Prof. H. H. Chapman for delivery to you in case of my absence and for such other use at the meeting or elsewhere as seems wise to him.

The proposed changes would make the Association over into a close corporation. It has no standing, and should have none, except as the embodiment and mouthpiece of enlightened, independent, and disinterested public opinion on forestry and forest policy. Under the proposed plan for seven permanent directors public opinion will be effectually silenced in the Association, and this will be true notwithstanding the fact that the new plan provides for the election of eight of the fifteen directors by the membership, for if but one of the eight should join the seven permanent members they would absolutely control the Board. Such an organization will make it easy for selfish men, having interests directly contrary to the public interest in the matter of forest conservation, to gain control of the Association. They would have every conceivable motive for using the oppor unity, and once in control it would be practically impossible to dislodge them.

I am informed that one inducement to the proposed change is an expected gift of a permanent headquarters and considerable sums of money. These are not sufficient reasons for the suicide of the Asso-

ciation as an organ of public opinion. A gift conditional upon so radical a change in the organization is on its face improper, and should be declined. It is also obvious that the acceptance of large gifts from certain quarters, whether conditional or not, would weaken or destroy the righteous influence of the Association, if known, and that the greatest care should be exercised to avoid any appearances that would give any real or fancied basis for suspicion of improper influences.

I am further of the opinion that the Association should live up to the highest standards as to the manner and cost of its solicitation of funds, and that the membership and the public generally should have ample assurances to this effect.

Sincerely yours,

PHILIP P. WELLS,

Vice-President, Connecticut Forestry Association.

REVIEWS

The Relation of Plant Succession to Crop Production. By Adolph E. Waller, Ph. D. Ohio State University Bulletin, XXV, 9, 1921. Contribution in Botany No. 117.

Foresters who are interested in the evolution of present-day vegetation find difficulty in passing without careful scrutiny any serious effort in the line of ecology. The paper under review, which is highly readable and instructive, attracts at once by its rather ambitious title, which suggests the idea that *if* there is a close relation between plant successions and crop production, the delineation of potential forest land through a study of successions should be a fairly simple matter. The reviewer believes that this is to some extent the case, but the paper by Waller seems to show that the value of land for crops is almost wholly dependent on edaphic factors, which influence the cost of production, while in the formation of climaxes climatic factors are fully as important. The paper is divided into three main parts:

Part I, Plant Successions, is a general discussion of the more important principles of ecology, directed, as the author states in his introduction "toward farmers, albeit they may be a special group of farmers. Most of the members of this group will be interested in the scientific aspects of plant life." We shall return to this section.

Part II, Factors Influencing Crop Distribution in the United States, is devoted to a discussion of the general relations between climatic, edaphic and *economic* factors on the one hand, and the dominance of certain crops on the other. The northeastern evergreen forest region is dominated in agriculture by timothy, spring wheat, rye, buckwheat and potatoes, all crops which do best in a rather cool climate: Corn, winter wheat, oats, red clover and beans overlap on the regions of the central deciduous forests and the prairies. These crops predominate in a region where the ratio of rainfall to evaporation varies from 60 per cent to over 100 per cent. The author, therefore concludes that the growing of these crops, and particularly *profits,* is dependent rather on edaphic or topographic than on climatic conditions. It is pointed out that oats and corn do not ecologically belong together, but are grown most abundantly in practically the same region because the one supplements the other. Oats for horse feed are necessary for *profits*

in growing corn. Similarly it is pointed out later, with respect to Ohio, that wheat is grown in the same region as corn largely because it is a good complement to corn in rotation.

Other well known facts of crop distribution are mentioned, but we believe the forester will find greatest interest in the attempt to reconcile natural crop dominance with dominance as dictated by economics. The importance of industrial centers, and the somewhat familiar idea of rent circles about these centers, which determine the need for intensive farming and hence the character of the successive, concentric crop zones, are discussed. These ideas have been used in forest economics and are especially good ones for the ecologist to keep in mind.

Part III, Crop Regions of Ohio, brings us still closer to the struggle between natural or ecological factors and economics, for Ohio is a State with many important cities. On the one hand the geology and glacial history, topography and soils, climate, natural vegetation centers and crop centers are discussed in such a manner as to constitute a very valuable monograph on the State. On the other hand, the correlation which is shown between crop centers and natural vegetation centers or the factors which produced them, is somewhat vague, possibly because of the economic factor. We believe the argument might have been much more convincing had the available data by counties been used, instead of dividing the State into four arbitrary quadrants. It is to be regretted that more effort was not expended on this chapter, and on detailed maps, and perhaps less on the general discussions of the first section.

As a closing argument there is given a discussion and two maps of the land values of the State. The first map shows the relative land values of the State for tax purposes, and the second the same data with the local influence of population centers eliminated as far as possible. The second map, we should say, has real ecological significance. Particularly are the land values influenced by the degree of glaciation. The southernmost part of the State, which was never covered by an ice sheet, has the lowest values, though receiving the greatest precipitation, while the large area of highest values, contiguous to Lake Erie, corresponds closely to the outline of the old glacial Lake Maumee, which persisted long enough to silt over the glacial deposits. It is possible that some of this value, however, is obtained indirectly, as through the advantage of commerce on the Lakes.

Looking back from this point, it is seen that edaphic factors as represented in land values or *productive capacity* have only a small

influence on crop distribution, while topography, both in its influence on local climate and its bearing on cultural methods, has a prominent influence, and general climate, again, influences the distribution in a rather broad way. To avoid confusion with an earlier statement, let us repeat that productive capacity, as influenced by soil and climate, while making the land profitable or unprofitable, does not so directly influence the *character* of the crop as do factors affecting cost of production.

The first part of this paper, as has been stated, is a general discussion of ecological principles, and while presenting an interesting outline, we are frank to say that it gives the whole paper a top-heavy appearance, occupying nearly half of the whole space. As the subject is not particularly new, we trust that a frank criticism may be as much in place as a full review. The discussion is for the most part orthodox, yet contains many good passages which should be credited to the author. On page 14, for example, we read: "A habitat then does not so much consist in rocks or hills or lake, as it does in so much moisture, so many degrees of heat, such an amount and quality of light. A habitat is not viewed dynamically until it is placed on a strictly factorial basis. The field worker *sees* plants growing in sand along the seashore. He must *think* of them in terms of the water balance of the plant, the abundance of light, temperature, and so forth."

We quote this passage as an admonition. Too often the ecologist, even after careful instrumental records are secured, *thinks* only as he *sees* things superficially. In this connection we wish to refer to a passage in the description of the ordinary succession in a habitat beginning with rocks and culminating with a deep humified soil. In the later stages of this succession, we read on page 32: "By the time a heath stage has been reached the cliff is usually well covered. This stage is succeeded by a shrub stage and often by a coniferous stage. Gradually oaks come in, increasing the shade and lowering the water loss from the soil as well as the oxidation rate of humus. The oaks are succeeded in time by more *mesophytic* trees—beech and maple, which are again the culmination of the successions. In all of this series the action of the plants has been toward an *increase* in soil and moisture until the conditions became suitable for plants like beech and maple."

It is not, perhaps, technically correct for a reviewer to inject too much of his personal opinion, especially if he has not space to present his arguments in full. We can not, however, subscribe to the idea conveyed by co-joining the two words above which we have placed in

italics. The error is not original to Waller; it goes back a great many years. Nevertheless we feel bound to controvert it whenever and wherever it appears. Briefly, our idea is:

All successions are toward greater xerophytism, if we use this word to describe the low water requirements of the plant. They begin either in free water or in very young soils. In an undrained glacial bog, the succession from aquatic plants to the xerophytic spruce may be almost direct, because of the high concentration of the stagnant water. From fresh water and from fresh soils as a beginning, we may have many more stages before xerophytism is reached. Free drainage in a young soil keeps the soil solution always at a low osmotic pressure. Aging through topographic change reduces drainage, and simultaneously the constant addition of humus increases the solutes in the soil and raises the osmotic pressure. In the final struggle of a seedling, the success of which determines the character of the plant formation, the *quantity* of water available is practically not a factor. The success depends on whether or not the plant exerts a sufficiently strong osmotic pressure to absorb the water, and possesses a correspondingly economical transpiration rate. In the later stages of succession, when competition for light is keen, the struggle is likely to go to the plant which is most efficient in photosynthesis. The shade-enduring species withstands the greatest degree of drought. The terms as here used have, of course, no application to the desert climax, in which the *static* condition has produced specialized plants of a stagnant, frequently dormant, character.

While then, the advanced stages of succession do ordinarily produce a soil of greater moisture-holding capacity, this merely encourages the initiation of a greater number of individuals and a keener competition for the moisture and light. The character of the plant formation can not be in any sense the result of mass-action. It is absolutely a struggle of individuals, which is probably more keen between individuals of the same species than it ever is in a mixed association. The idea which I wish to convey is that we lose the ecological significance of the facts when we give weight to the statement that the plants of the climax formation, *in the aggregate*, require more water than the earlier stages. We lose sight of the fact that the individual must be equipped for a very keen struggle both for moisture and light.

In the discussion of climatic factors a number of good points are brought out by Waller, among which might be mentioned the idea that it is the extremes of heat and cold, not the mean temperatures, which kill plants and hence are important in distribution; as to light, in its broad distribution, it is asserted that it is rarely a limiting factor. We wonder, however, if this may not be controverted by the recent

discovery of the importance of measured light in flowering, seeding, etc. Waller concludes that in a broad way the water supply is most directly controlling, since plant formations do not parallel closely the temperature and light zones of the earth.

In the discussion of soil factors another statement is made to which we take exception. This is the suggestion that the sandy barrens of the Southeastern United States do not support plant growth because of low available moisture and lack of mineral salts. The success of planting experiments, both in Florida and Michigan, indicates the falacy of this idea, especially as the poor sands of Michigan are found to support white pine quite well, while formerly given over to jack pine and Norway pine. We have reason to believe that the limiting factor on these barrens is excessive temperature of the surface soil, due, primarily in both cases, to their quick drying at the surface.

In the discussion of biotic factors we are surprised by the lack of any definite reference to the so-called "damping-off" fungi, which we believe to play an important part in establishment, at least with forest tree seedlings. We also encounter the statement that the white pine blister-rust attacks the western yellow pine. This is at least misleading, since our latest information states that this fungus has not appeared west of the Mississippi. C. G. Bates.

The Teaching of Fire Prevention. State of New Jersey Department of Public Instruction, Trenton, September, 1920.

Fighting Forest Fires. State of New Jersey Department of Conservation and Development, Trenton.

Fires for Fun. State of New Jersey Department of Conservation and Development, Trenton.

The above three publications from New Jersey rank high among the publications of this sort being issued in increasing numbers by the various States for forest fire prevention propaganda purposes.

The first of these, "The Teaching of Fire Prevention," is particularly noteworthy at the present time from the fact that there is a movement on foot to have all the States, whose legislatures meet this year, adopt the policy of the State of New Jersey in requiring the teaching of fire prevention in all public, private, or parochial schools. It is this pamphlet which is being used by the State of New Jersey to carry out the provisions of this educational compulsory law.

The pamphlet is one which was originally got out for the United States Bureau of Education by the National Board of Fire Underwriters as a fire prevention manual for the school children of America. New Jersey has simply adopted this manual and added a chapter on forest fires prepared by State Fire Warden C. P. Wilber. In this way forest fire prevention will be brought to the direct attention of every school child in the State of New Jersey from now on. Mr. Wilber is entitled to great credit for the way he made use of the opportunity presented by the enactment of this law in New Jersey.

The two other publications are also from Mr. Wilber's pen and are both highly commendable. "Fighting Forest Fires" presents in a very simple straightforward way, which can be readily understood by the average man or woman, how they can best go about suppressing any forest fire which may come to their attention. It presents in logical sequence the general situation with reference to forestry in the State and its dependence upon the control of fires, what the most common causes of fires are, what principal features the forest fire law covers, how the forest fire service is organized and operates, after which the subject of fires themselves is very carefully considered in its numerous details. The publication is further noteworthy because of the particularly appropriate illustrations. These in themselves tell a running story, closely paralleling the text. "Fires for Fun," as its title indicates, presents the subject of camp fires from the angle of every type of pleasure seeker who journeys to the woods for an outing. This publication is noteworthy for its illustrations also, which of themselves are of such a character as to carry conviction without the use of any other text than the legends accompanying them. They are, furthermore, unusual in that they are not photographs of camp scenes which approximate the conditions which it is desired to portray, but are sketches prepared on a well-thought-out plan which illustrates more clearly than any photograph possibly could the point which it is aimed to drive home.

L. S. M.

The Fungal Diseases of the Common Larch. By W. E. Hiley, M. A., School of Forestry, Oxford, Eng. Oxford, Clarendon Press. Pp. 1-204, figs. 73. 1919.

Hiley's Fungal Diseases of the Common Larch is a monograph that was initiated by a special investigation on the larch canker. Two

chapters were added on the heart rot caused by *Fomes annosus,* a root rot that is very prevalent in England and on the Continent; a short chapter dealing with the heart-rot fungi *Polyporus schweinitzii, Poria vaporaria, Polyporus sulphureus,* and *Trametes pini;* a rather extensive chapter on *Armillaria mellea,* and a brief concluding chapter on various leaf and seedling diseases. The author reviews the literature in each instance, describes the disease, and gives a detailed account of the causal organism, its mode of action, reproduction, infection, etc., the factors that contribute to its activity, and the approved methods of prevention. The illustrations are well-chosen and well-executed. The amount of new materials presented is proportionately small, but from a pedagogical point of view this little volume is of very great excellence. It is a book which foresters and students of forest pathology will read with fascinated interest.

J. H. F.

Root Development in the Grassland Formation: A Correlation of the Root Systems of Native Vegetation and Crop Plants. By John E. Weaver, Carnegie Institution of Washington. Publication 292. Pp. 151, 39 text figures and 25 plates of which two are colored.

This is the companion volume to "Ecological Relations of Roots" by the same author reviewed by Dr. Toumey in the JOURNAL OF FORESTRY, 17:990-993, 1919. Since the publication of the latter, the author has extended his investigations to more than twenty-five stations in the grassland associations of Kansas, Colorado, South Dakota, and Nebraska. More than 1,500 root systems were examined and for practically all of the species, the root systems were excavated almost in their entirety, including thirty-eight new root systems of important species of the prairie, sandhills, and plains and more than eighty examinations of the root systems of crop plants in widely varying soil types and conditions of growth.

These studies revealed marked differences, either in the lateral spread of roots, depth of penetration, or output of branches. These changes were in most cases correlated with changes in the water content of the soil. A close correlation between depth of root penetration and efficient rainfall was noted. Soil texture was found to exert a direct influence upon root development through water content and aeration. Variations in behavior appeared to be responses to dif-

ferences in the evaporating power of the air and the water content of the soil, with differences in the abundance and distribution of nutrients occasionally playing important rôles. The root development of crop plants showed a nicety of correlation with the root development of certain native species in similar habitats. A knowledge of the development, position and competition of roots is held to be indispensable in an accurate interpretation of plant succession and the indicator significance of native vegetation.

Although the monograph under review is not directly concerned with trees or forest vegetation, it is deserving of more than passing notice because of the most convincing results presented and the clear-cut exposition of the methods followed in this extremely fruitful field of ecological research. What little work has been done on the root systems of forest trees and associated forest vegetation, indicates that these studies are equally fruitful. The strenuous manual labor involved in excavation should no longer preclude similar researches along silvical lines.

C. F. K.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Forests of Brazil and Paraguay

McGinnis states that with the possible exception of the Congo and the Cameroon in Equatorial Africa the tropical hardwood forests of Brazil are the most extensive in the world; while 48 per cent of the land surface of Brazil is forested, much of this has little value for lumber. Brazil is credited with 197 million acres of so-called "pine," but in reality *Araucaria*, largely high grade, said to average a higher grade than the best of the white pine stands of the United States ever yielded. The lumber is said to resemble closely white pine, except it is heavier. Brazil's hardwood forests may be divided into three main areas: Amazon basin, Atlantic slope, and Southern or east of the Parana River. The Amazonian forest runs approximately 70 per cent forested and 30 per cent campo or brush lands. The Atlantic slope area contains some of the most beautiful and valuable cabinet and veneer woods in the world. The third division is at a higher elevation, the climate healthful; exploitation is going on here, 250 miles of railroad having been built, and many sawmills established. Wasteful methods of logging as well as in clearing of land for farming prevail. Forest fires are almost unknown, though in seasons of very unusual drouth fires have been known to run through the forest for 100 miles. Vines and small undergrowth are scorched but the forest in general is hardly injured. The valuable woods do not occur in pure stands but are much scattered, nor do the individual trees attain any great height, the boles usually are crooked and with not over one or at most two 10 to 14 foot logs. Few of the valuable species or Brazil or Paraguay are not "sinkers," the cedro being the exception, and is thus used as a "floater" for other species. No extensive exploitation of the tropical forests will come until there are systems of logging railroads built. J. D. G.

McGinnis, D. R. *Tropical Forests of Brazil and Paraguay.* Timberman, Jan., 1921.

UTILIZATION, MARKET, AND TECHNOLOGY

Southern Mexico Lumber Possibilities

With an apparent return to normalcy in the Government of Mexico predictions are that lumbering in the southern republic will receive a decided impetus, especially in southern Mexico. Here there are large and valuable forests, principally of mahogany, Spanish cedar, oaks, and two species of Zapote, one of which is the source of chicle. The country is level, the stands run from 10,000 to 15,000 feet per acre. The above data apply in Tehuantepec. J. D. G.

McMullen, W. H. *Lumber Possibilities of Mexico.* Timberman, Jan., 1921.

Siberian Timber

Siberia's timber resources are described in some illuminating details in this article by Teritch, of Vladivostok, who gives the figures. The figures in the table following are exclusive of Cossack-owned and peasant-owned forests which total some 35,000,000 acres additional, nor do they include forest land in Transbaikal and Yakietsi provinces or on the shores of the Okhotsk and Bering seas, a total of 540,000,000 acres additional:

Forests	Forest area, acres	Forest stands, acres
Maritime Province	110,440,000	71,462,850
Amur	94,070,700	31,849,975
Kamchatka	27,000,000	1,314,900
Sacholin	6,750,000	6,750,000
	238,260,700	111,377,725

The stands run mostly to conifers—fir, spruce, pine, and larch. Present consumption of timber is about 1 per cent of the annual growth. Exploitation methods and equipment are of the crudest; there is not one mile of logging railroad in Siberia. Sawmills are equipped with German or Swedish frame saws; there is not a single American band saw in the whole territory. Extensive development and use of these immense forest areas is dependent on Russia's future government, whatever it may be; but the author believes that Americans have a wonderful opportunity in Siberia. J. D. G.

Teritch, W. *Describes Siberia's Timber Resources.* American Lumberman, Jan. 8, 1921, p. 73.

Scottish Timber and Forestry

Today timber imports into the British Isles is small compared to pre-war days. This is not due to wood substitutes but largely to the labor situation in England. The use of native timber in England and Scotland especially for pit props began during the war, and has continued in a lesser degree, due to a realization of the possibilities of such use, the cutting off of the French pit prop supply from the Landes, and to the acute labor situation in England. The Highland railways in 1914 carried about 15,000 tons per annum of "home-grown" timber products; now they carry 104,000 tons, and at a far higher freight rate. The Scotch requirements for pit props are being met not only from Scotland but for England as well, from the Highland forests. This new use of the Scottish forests is a great stimulus to reforestation and general forestry practice; broadly speaking, something rather new in Scotland and England.

Before the war only about 5 per cent of the home timber was used in the coal mines: thinnings and props were allowed to lie and rot in the woods as they would not pay for labor and freight, even though there was free stumpage. J. D. G.

Dunlap, J. Y. *Home Timber in England and Timber Supplies.* Lumber, Dec. 27, 1920.

Timber Imports Almost Equal to Exports

The National City Bank is authority for the statement that the exports of timber, lumber, and other forest products from the United States for 1920 are to be placed at 200 million dollars' worth, as compared with 70 million dollars' worth annually exported during the war period. Canada's 1920 timber exports will equal our own. In pre-war days our annual exports ran about 75 million dollars' worth. The obvious reasons for this increase are the rehabilitation demands of Europe, the temporary stoppage of the Russian supply, and probably the fact of a large number of American-owned bottoms. Prior to the war Russia was our chief rival in the lumber markets of the world, in 1913 her timber exports being valued at 75 million dollars. Our timber and forest products are going to Asia, Oceania, South America, and South Africa. Europe is taking largely our oak and pitch pine lumber, having bought in the first eight months of 1920 some 13 million dollars' worth. In spite of our large export trade in lumber we are importing timber and timber products

of almost equal value, buying 48 million dollars' worth alone of wood pulp from Canada, Norway, and Sweden (first eight months of 1920), approximately 7 million dollars' worth of tropical woods, and 40 million dollars' worth of Canadian lumber in 1920. J. D. G.

New World Demands Upon Our Forests. West Coast Lumberman, Nov. 15, 1920, p. 67.

MISCELLANEOUS

Mountain Climbing Clubs of the Northwest

With the growing interest in nature and wild life, in the forests and mountains, outdoor and mountain climbing clubs are becoming recognized by foresters as organizations on whom they can rely as allies. In the broadening of the recreational use of the National Forests in the North Pacific region at least the Federal and State forest officers have found warm supporters in the full but proper use of the forests by such organizations as the Mazamas of Oregon and the Mountaineers of Washington. Each of these mountaineering clubs issue publications which are worthy records of their many trips over trails and to the summits of peaks within the National Forests. Forest officers are members of and co-operators with these clubs. The Mazamas, founded in 1894, have shown their interest in the forests in a most practical way, by the construction of forest trails, in making and putting up trail signs and markers, and in inculcating a sentiment in those who love and use the outdoors, of healthy regard for the rights and health of the other fellow, by insisting on sanitation and the utmost care with fire.

The last volume of the Mazama, of 100 pages, the publication of the Mazamas which has been issued since 1896, contains readable records of their 1920 trips, with much historical and some scientific data of note. This last volume is No. 1 of Vol. VI.

The latest issue of the Mountaineers' annual contains accounts of several trips to peaks within National Forests, an article on the Indians of the Olympic Peninsula, several illustrations by forest officers, and acknowledgments to hearty co-operation by forest officers. The Mountaineers were first organized in 1906 and this is Vol. XIII of their publication. J. D. G.

Mazama, Vol. VI, No. 1, Portland, Oreg., 1920. *The Mountaineer,* Vol. XIII, No. 1, Seattle, Wash., 1920.

EDITORIAL COMMENT

The American Forestry Association Turns a New Leaf

About forty years ago a small group of enthusiastic and unselfish men and women devoted to the cause of forestry organized the American Forestry Association. Its mission was to bring about the establishment of forestry in this country. Its educational work in the early days, and its constructive proposals were largely responsible for the first steps taken in American forestry. For years it not only was an instrument for spreading information about forestry, but was the means of organizing the friends of forestry in support of forest legislation, both at Washington and in many of the States. It was an effective source of propaganda; it was also a powerful force in meeting selfish opposition and securing public action.

Those of us who twenty-five and thirty years ago were struggling, in the face of public indifference and powerful opposition, to set in motion an effective movement in forestry, found in the American Forestry Association a rallying point, an associated group of men ready to fight for a principle, an organization aggressively taking the leadership in forestry. It helped secure Federal and State legislation; it also stood back of the Federal and State officers in their struggles, often against great obstacles, to make their work effective. Every forester felt behind him the strong arm of the organized forestry interests of the country, in the American Forestry Association.

It is with this background, and the knowledge of what the Association started out to do, and might still be doing, that we view the action of the Board of Directors on February 25, 1921, which has seriously impaired, if it has not brought to an end, the usefulness of the Association as representing the organized interests of forestry in the country.

For a number of years the Association has been drifting away from the ideals of its founders. More and more its objective has been restricted to propaganda regarding forests and to the effort to create a general interest in trees, forests, and wild life. Less and less has it acted as a fighting agency of the organized forestry interests of the country to clarify public issues, to lead in carrying them forward, to

back up foresters who, often single-handed, have had to meet the most powerful opposition in their struggle for the public welfare.

The officers of the Association are of course right in their theory that it is their duty to educate the public to an interest in trees and forests, by a popular magazine and by other means of publicity. But this should be only one function. There has been a deep-seated criticism of the Association among foresters, not because of disapproval of its publicity work, but because it has ceased to be an effective fighting force in the various public issues, National and State, and because in their efforts the foresters have not had it back of them with the power of organized public sentiment to aid them in carrying on. These men, who had a right to vigorous support of the Association, have seen its officers stand aside in the big issues, refuse to fight, remaining neutral in vital crises, negative as an influence when a public controversy was involved.

A few years ago the big issue was whether the National Forests should be turned over to the States and the whole system broken down. Where was the American Forestry Association? Its President refused to take a stand on that issue. We won the fight, but with no help from the Association. Today the big issue is whether the public will exercise over private timberlands the control and regulation necessary to prevent permanent injury to the interests of State and Nation. For months the Association declined to take a stand on the proposals of the Forest Service. It is now backing the Snell Bill which is drawn in such adroit language as to be capable of more than one interpretation. I interpret it as a bill calling for definite public regulation. I understand that others do not see in it any regulation of private timberlands except perhaps in connection with fire protection. Certainly some of the backers of the Snell Bill are on record as against any mandatory legislation except in fire protection. I do not know where the Association stands on this issue, for it has avoided taking a clear-cut stand. These are but two national issues in which it has failed. An enumeration of others would be a list of the forest struggles during the last few years in which foresters have stood for principles, often to the sacrifice of good will and position, and without any real backing from the American Forestry Association.

A new step has now been taken. The Board of Directors has deliberately taken action to change the democratic and representative character of the organization. It voted for a change of by-laws that

makes the Board self-perpetuating, controlling policies, financial management, and election of officers; and this action was approved by the meeting of February 25. If the function of the Association were only to publish a popular magazine, and carry on general publicity in forestry, but little harm would result. But great issues are ahead of us. The Association should be the instrument through which all friends of forestry could speak. But now that is impossible. The Association should be the strong right arm of the foresters and friends of forestry to fight for right principles. But it is ruled by a group of men intrenched permanently in full control, and these same men have already repeatedly failed to make it an aggressive force in critical issues, and have refused to take any part at all in various of the most important situations.

It was an amazing meeting on February 25. The by-laws were rushed through with very little discussion. I, myself, have never yet seen any statement showing the necessity for the changes. No such statement was made at the meeting. I learned from one of the life directors that a large donation had been offered to the Association on condition that it be governed by a self-perpetuating board. The reason seems almost incredible. The changes in the by-laws likewise seem almost incredible; and it is still more difficult to believe that any group of men would undertake to intrench themselves permanently in control of an organization established for a great public movement, with the grave dangers to the public interests that in the long run are involved in such a form of organization with its delegation of autocratic powers to a few men. What the real motive is for this astonishing action has not yet been revealed.

Now we learn that the National Information Bureau, composed of public-spirited men of high standing, has refused to approve of the American Forestry Association, as a body worthy of public support. This refusal is based on the present form of organization and certain methods connected with the fiscal administration which are not sanctioned in quasi-public associations of this kind.

There is one thing that an association engaged in forwarding a public movement must have above all else, and that is the confidence of both its members and the public. Without that confidence it can not speak for its members, nor in the name of the public. The officers and directors have themselves struck the Association a crushing blow that has already destroyed the faith of many persons in the purposes of the

Association, in its stand on vital issues, in its readiness or ability to serve as the spokesman of the cause of forestry in America. I myself, share in this loss of trust, and I consider that, unless there is a radical change in policy and leadership, the Association is not worthy of the confidence of the public.

It is imperative that the rank and file of the members of the Association, whose sole interest is in the success of forestry, know just the position in which it has been placed by its officers. Only the force of sentiment on the part of the members, demanding a leadership and management in which they and the public can have confidence, will enable the Association to recover its former worthy position and influence as representing American forestry.

HENRY S. GRAVES.

WHAT IS TO BE DONE?

The American Forestry Association has lost its moral right to speak in the name of the public and of forestry. As long as we believed that it might still reform we kept silent for the good of the cause. The last bold attempt to perpetuate forever the present administration, however, makes us feel that we would not be true to ourselves and to our public obligation if we remained silent any longer. We do not counsel hasty action, however. All true friends of forestry must remain calm and weigh all the facts before making up their minds as to what their duty should be under the circumstances.

The JOURNAL plans, beginning with this number, to present to its readers facts and documents which will place the present administration of the Association in its true light. We open the pages of our magazine to members of the Board of Directors to justify these facts if they can. We believe that the rank and file of the Association do not realize the situation in which the Board of Directors has placed them and are not responsible for its actions or policies. It is the officers and not the membership that must be brought before the bar of public opinion. It is not a question, as some directors of the board tried to give the impression, of a struggle for the control of the affairs of the Association between foresters and non-foresters; it is merely a question of public service. The foresters have assisted in every possible way in the development of the American Forestry Association and yet remained in the background. They are willing to stay there as long as

the leaders of the organization remain true friends of forestry and are imbued with the old spirit of public service. We are willing even that there should be no professional foresters among the directors of the board, but we must insist that those who assume to speak for the Association in the name of the public and of the cause of forestry in this country, no matter whether they are lumbermen, presidents of universities, or plain business men, should be unselfish people of whose devotion to forestry there can be no doubt.

EDITORS.

After the Meeting of the A. F. A.—Ruminations of a Forester

In a quiet spot amid the forests a famous forester lies buried. His graveyard is marked out by oak trees. With due reverence this spot has been visited during the past century by those who have chosen a life of unselfish service. The desire for wealth has been set aside for the joy of studying nature and protecting her treasures for the use of present and future generations.

What would the shades of these foresters of the past have felt had they witnessed in the flesh the debacle of February 25, when the steam roller of gathered "members" outvoted a few faithful supporters of National Forestry. The confidence of the minority was only increased by the completeness of their defeat. What a spectacle to see men with a quarter century of public service outvoted by mere slips of girls impatient to be gone to their work or pleasure. How many of them knew the meaning of American forestry? Had they ever seen a commercial forest? They had been asked to vote and they voted—perhaps a little wearied of hearing discussions of life directorships—but committed to the faithful support of that great patron of generosity and of publicity—CHARLES LATHROP PACK! whose name is certain to go down in forest history. "What do foresters know of the art of publicity," he said after sternly shouting a tribute to his Secretary paid at the rate of a cabinet minister from the coffers of the American Forestry Association. What would the sixteen thousand members have decided had they not been denied a referendum vote? We shall never know.

In the American Forestry Association the spirit of Fernow and Pinchot has died. The true force of that Association, dormant for a decade, has died. From now on it will be like a battery firing blank

charges. Noise to be sure, but never the telling effect of honest shell.

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The holiday was over and the crowd was gone. A smiling woman of generous proportions was cheerfully gathering up ballots and other papers. "We did well, didn't we?" she said, mistaking me for a voter. "Perhaps so," I replied, and walked away.

T. S. W., Jr.

Has the Society Changed Its Mind?

Last summer the Society voted 3 to 2 in favor of Federal control of privately owned timberlands. The wording of the questionnaire, in the opinion of several members, did not allow an expression of opinion as to whether they would prefer Federal control rather than control by the individual States. A resolution was passed, therefore, at the last annual meeting, providing for a new referendum specifically between State control, as exemplified by the Snell bill, and Federal control, as exemplified by the proposed revised Capper bill. The ballot, which was concluded on March 15, resulted in 195 votes for the Snell bill and 109 for the revised Capper bill, or almost 2 to 1 in favor of State control.

A number of those voting explained that they really believe in Federal control, but voted for the Snell bill for reasons of expediency, or with the idea that it should be given a trial as a stepping stone to Federal control later on.

It is significant that out of the large number voting (304), no one expressed himself as against any public control at all. Since, therefore, the sentiment of the Society, so far as it could be ascertained from this ballot, is unanimous for some form of public control of privately owned timberlands, it is interesting to speculate on whether the latest verdict will again be reversed, within a year or two, in favor of outright Federal control. The policies adopted in the meantime by the important timber States will be carefully scrutinized.

Is Texas Showing the Way?

There is now a forest bill befor the Texas legislature. Among other things it provides for the appointment of a State Forester by the Directors of the State Agricultural College, the establishment of State nurseries to supply seedlings at cost, the acquisition of lands for State

forests, and penalties for the setting of forest fires. Aside from protection against fire, the only measure looking toward the prevention of forest devastation is a provision to the effect that at least one pine seed tree not less than seven inches in diameter shall be left standing on each acre after lumbering, provided, that this measure shall not apply to lands which the owners declare to be susceptible to cultivation, and which they declare is intended for agricultural purposes. A severance tax of 12 cents per thousand feet of lumber and of 5 cents per barrel on crude gum is called for.

A committee of lumbermen, presumably representing the lumber industry of Texas, has filed a brief against this bill. This committee argues that the State Forester should never have the power of *control* over forest interests in the State, and that the lumber industry should not be subject to control by any one official or by any one power other than the legislative power of the State; that the severance tax is objectionable because it is class legislation, and that money obtained from the lumbermen should not go to other interests (such as shade tree planting and nurseries); that protection against fire would be of slight benefit only; that the growing of pine seedlings in a nursery for purposes of transplanting is "absurd," as pine can be successfully grown only from seed; and that it would cost from $75 to $100 per thousand board feet to grow standing timber.

At the hearings on the bill the spokesman for the lumber industry of Texas argued that when our own saw timber was gone we could easily obtain lumber from Russia; that fires did not seriously retard forest reproduction or the growth of timber, and that nature would eventually reforest lands in Texas without assistance from the State.

The emptiness of all these objections is so apparent as to make discussion quite unnecessary. The general opposition of the lumber industry, however, is of decided interest. Here is a bill looking toward the perpetuation of forest growth in Texas. Its provisions are so mild as to raise the question of whether it would really accomplish much, if passed. The seed tree provision, for example, need not be complied with if the owner declares his land to be susceptible to cultivation and intended for agricultural development. The owners would have wide discretionary powers in this respect, for their say-so would be final. We are wondering what per cent of cut-over lands the owners would class as being not susceptible to cultivation.

However, in spite of the ultra-reasonableness of the bill, it is being

fought openly and secretly by the lumber interests of Texas. Of peculiar interest at the present time is the fact that the leading lumbermen of Texas are also of leading influence in the National Lumber Manufacturers' Association, an organization which is now supporting the Snell Bill in Congress. The forest bill in Texas aims at State control over forest devastation along the lines of the Snell Bill. Are both ends being played for the middle?

Here is a bill calling for the moderate tax of 12 cents per thousand feet of lumber. This, according to the lumbermen, would be a heavy burden upon the already over-taxed consumer. As a matter of fact, in the average man's house the total increased cost due to the severance tax would be about $2.50. Here is a bill which provides for the leaving of one small and forlorn seed tree on each acre, a provision which is further so qualified as to mean little or nothing. Here is a bill aimed at the establishment of systematic protection against fire, a measure of great value to lumbermen, as well as to the State as a whole. Here is a bill intended to create and maintain a non-partisan, business-like administration of forest affairs in the State of Texas, a thing to be greatly desired in the public interest. And still this bill is being done to death by the lumber industry.

The advocates of State control over forest devastation have believed this policy to be a wise one on the grounds that it was democratic and expedient, and promised the quickest results. The advocates of Federal control have charged that the States were powerless to cope with a nation-wide problem of this character, and that the legislatures of the forested States would be dominated by lumber lobbies which would effectually block any real accomplishment. Is Texas showing the way?

NOTES

Association of Michigan Foresters

On January 7, 1921, a meeting of Michigan foresters was held in Lansing for the purpose of discussing a revised State forestry program for presentation at the next meeting of the Michigan Legislature. There were present at this meeting Professor Watson, of the Forestry Department of the University of Michigan; Huber C. Hilton, Supervisor of the Michigan National Forests; F. H. Sanford, Forester for the Michigan State Farm Bureau; Professors Chittenden and Buttrick, of the Forestry Department at Michigan Agricultural College, as well as one or two invited guests.

The meeting canvassed thoroughly the forestry situation in the State and passed a number of resolutions covering desired changes in State laws and policy. These resolutions were sent to Governor Groesbeck and communicated to the press.

The resolutions embody the following points: First, That there should be organized by the Legislature a Department of Conservation, divided into three bureaus, as follows: (1) Bureau of State Forests, State Parks, and State-wide fire protection; (2) Bureau of Natural Resources, including geological survey, and (3) Bureau of Wild Life, including fish and game protection and propagation. Further, that the Governor should appoint to preside over this department a director and to appoint superintendents of the different bureaus, these superintendents to be the best technically trained men available along these several lines.

Second, That work relative to State forests, State parks, forest fire prevention and reforestation throughout the State should in any event constitute a single department to be known as the Department of Forestry.

Third, That the need of protection of forests and forest land from fire has not been fully realized by the people of Michigan or by any department of the State government and that irrespective of any reconstruction of State departments, that a sufficient appropriation for a highly efficient fire-fighting organization be provided by the Legislature.

Fourth, That legislation should be enacted, making possible the

fullest use of all resources of State forests and parks along economic and recreational lines under permits and regulations of the State Forester.

Fifth, That a forest and soil survey should be made immediately of all lands in Michigan to determine which lands are better suited for farming than for forestry purposes and that legislation to accomplish this should be enacted.

Sixth, That for purposes of encouraging reforestation, laws should be enacted so that a land tax can be collected annually at the local tax rate on the value of bare land, and a deferred yield tax on timber when cut.

Seventh, That the planting of trees along the State highways should be encouraged and that an adequate appropriation should be made therefor in accordance with the Highway Planting Act passed by the Legislature of 1919.

Eighth, That tree surgeons practicing in Michigan should be licensed and subject to such rules and regulations as may be determined by the Licensing Act.

Ninth, That Governor Groesbeck be requested to call a conference of all citizens of Michigan interested in the problems of conservation of the State's resources and the utilization of State lands, and that plans be submitted to him for the program of such a meeting and that he be requested to extend an invitation to prominent foresters and others interested.

The meeting voted to organize itself into an informal organization to be known as the Association of Michigan Foresters, and adjourned subject to call of the Chairman, Mr. Sanford.

On January 22 a second meeting was called at Lansing. The chief business was the appointment of committees to draft detailed and definite recommendations for new legislation and for organization of the Association. These committees consists of a Tax Committee, a Fire Law Committee, a Highway Planting Committee, and an Association Committee.

It is hoped that these committees will soon be in a position to organize and that the new association will be placed on a permanent footing.

New York Forester's Club

The number of foresters who are now stationed in and around New York City has grown to such a figure that a foresters' club has been formed to hold monthly meetings the first Tuesday of each month. No name has been selected, and it may go without a name, as the group has been meeting informally for several months, and has just decided that its conferences are so interesting that they will be made slightly more formal.

The plan of the group is to make the meetings so well known in the profession that foresters who are planning trips to New York will adjust their schedules to make attendance at the monthly luncheons possible.

The group is headed by E. A. Sterling as chairman, and Nelson C. Brown as secretary. At the February meeting those present included J. S. Kaplan, E. C. M. Richards, C. C. Lawrence, O. M. Porter, Dr. Hugh P. Baker, W. E. Murchie, Barrington Moore, and Walter Spicer, in addition to the two officers, the schools represented being Yale, Cornell, and Syracuse.

The meetings are arranged on a strictly "Dutch treat" basis, there being no membership fee and no dues. All discussions will be devoted to the latest developments in the forestry profession, and discussions will be led, when possible, by speakers from outside of New York.

New Book by Woolsey

"American Forest Regulation" will be published shortly by T. S. Woolsey, Jr. It will contain a review of the best European forest regulation and also a constructive commentary on the application of regulation to American forests by Prof. H. H. Chapman of Yale University. Raphael Zon contributes a short chapter on "European Regulation Ideals." On account of the high cost of publication the book will be published with paper cover and will sell at $2 per copy, the edition to be limited to 500. Advance orders should be sent to T. S. Woolsey, Jr., 242 Prospect Street, New Haven, Conn.

Research in Forest Pathology Not Duplicated

Readers of the National Research Council Bulletin on "North American Forest Research" (Vol. 1, Part 9, No. 4) may have noticed an

apparent duplication in the statement of certain projects which might be taken to imply an actual duplication of work. For example, projects 207-210 in forest pathology are also covered by the general project 262, project 125 a-n by projects 264-5, etc. It should be explained that in each of these cases the same work is referred to, the duplication of entry being due to the fact that statements of the same projects were received from both central and local sources. Under the pressure of conditions involved in publishing this report the apparent duplication was not noticed. By relating the detailed statements under projects 207-10 and 125 with the more general ones under projects 262, 264, and 265, a better understanding of the scope and character of the Government co-operative work in forest pathology can be gained.

EARLE H. CLAPP.

CHRISTMAS TREES CUT WITHOUT DESTROYING THE PARENT TREE

In 1912 Supervisor Rush of the Wichita National Forest started a red cedar plantation of about 17 acres, the trees used being natural stock dug from surrounding territory. The plantation was a decided success, fully 95 per cent of the trees living. During the last two winters Rush has sold Christmas trees from this plantation—80 in December, 1919, and about 150 in December, 1920. In cutting these trees Rush has made it a point to leave one whorl of branches below the point at which the tree was cut off. A very interesting phenomenon has resulted. Physiologists would possibly say that it is due to heliotropism or to the force of gravity, but personally I rather imagine it is due to some natural force inherent in living things of which physiologists know little or nothing. Regardless of the reason this is what happened. Following the cutting of the trees, Rush in most instances cut off close to the trunk all but one of the living branches which remained on the stump. This living branch in every case has abruptly turned upward. On some trees it has reached a height of six feet, and there is the beginning of a new stand of cedar. Where Rush did not cut off all but one of the branches but left them as they were, the tendency for one or more of the branches to assume an upright growth has been much less apparent. This phenomenon is not only of scientific interest, but it may develop into something of considerable practical interest. If a crop of Christmas trees can be cut from a stand without actually destroying the parent tree, it certainly will have practical

interest. This phenomenon might not, of course, occur in cases of other species, such as spruce and fir, which are in greater demand for Christmas trees. C. R. T.

Wood That Does Not Rot

The Timber Trades Journal, January 29, 1921, page 299, says that the wood of the mangrove tree, which is found in French Guiana, is considered by the French as a wood that will not rot. All exposure and efforts to break down its fiber in four years' experiments by the French Railway Service have been useless.

The grain of the wood is so close as to practically exclude all moisture. Its density is placed at 110, as against 40 for fir, and 70 for oak. In addition to this closeness of fiber, the mangrove has a large amount of tannin in its composition. This protects it from insects and such blights as mould and damp. While not as brittle as oak, it has twice the resistance to flexion, and has about the same potency against crushing and twisting.

A Forest Experiment Station for Pennsylvania

The establishment and maintenance of a forest experiment station in Pennsylvania is provided in a bill (H. R. 15950) introduced in the House of Representatives on January 31 by Mr. A. H. Walters. The bill provides $40,000 for this purpose, to be available until June 30, 1922. The money will be expended under the direction of the Secretary of Agriculture, and the location of the station is left to his judgment. Provision is made for co-operation with the State of Pennsylvania and with any other agencies which may be interested to determine and demonstrate the best methods for the management of forest lands and farm woodlands in the Alleghany region.

Dr. C. A. Schenck, late Director of the Biltmore Forest School, and now in charge of the children's relief work at Darmstadt, writes that he would like to sell his library as a means of raising money for the underfed children in his old town, the city of Darmstadt. His library contains a complete set of *American Lumberman*, probably from 1895 to 1912, all bound. He has also many old-time American publications which are now hard to obtain, such as Sargent's Tenth Census Report, and others. He would like to dispose of all these to some American forester who might have use for them. His address is: Dr. C. A. Schenck, Lindenfels I. O., Darmstadt, Germany.

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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

HAS THE AMERICAN FORESTRY ASSOCIATION LOST ITS FORMER USEFULNESS?

REFLECTIONS OF A LIFE DIRECTOR

BY H. H. CHAPMAN

PART III—THE SECRETARY AND THE FINANCES

No organization can hold public confidence unless its financial policy is open and its statements available to the members, much less, when this policy is taken out of the hands of the directors themselves.

In the initial stage of reorganization in 1911 and 1912, a monthly financial report was sent to each director. The new Secretary, Mr. Percival Sheldon Ridsdale, a newspaper man from Wilkes-Barre, Pa., recommended by Editor LaGorce of the *National Geographic Magazine,* proved to be a man of considerable capacity in managing the details of the business, publishing the magazine, and soliciting for new members. As a spur to his industry he was given a contract, renewable annually by which he was to receive a certain per cent of the *net profit* shown on operating expenses for the year. Under this contract he worked during 1912-1914, within which period the Association discharged a net debt of $478.56 and accumulated a capital which on January 1, 1915, amounted to $9,107.28 which was increased to $14,107.28 by a bequest of $5,000 from Jane Smith. On January 1, 1916, this had been further increased from operating profits to $17,705.80. During this period practically no contributions had been received except the regular income from memberships and advertising. The Association, through its Secretary, had raised itself by its own boot straps from insolvency to the position of a solvent concern, with a membership of 8,039.

But the old contract basing commissions on net profit was not satisfactory to the Secretary who desired a more liberal arrangement. In January, 1915, Mr. Quincy, in whose hands the general guidance of the finances had come to center was empowered by the Board to draw up a new contract. When Mr. Quincy brought the matter of this contract before the Board for its approval the terms of the contract were not read nor were the directors furnished with copies, but a blanket approval was requested and given by the Board members present. This contract gave to the Secretary a salary of $5,000 per year plus 20 per cent of the gross income of the Association for five years, with certain reservations concerning donations and existing current income. The contract was signed for five years and expired on January 1, 1920. When a copy of this contract was finally obtained by him in February, 1915, an effort was made by one of the directors to have its terms reconsidered but this came to nothing. The nature of this contract is such that by increasing the gross expenditures of the Association, and by that means increasing the gross income, the Secretary's compensation is increased, regardless of whether a profit or loss is shown by such expenditure.

Meanwhile in the year 1915 Mr. Quincy put through a long considered plan of expanding the Association by raising and expending a sum of money through selling Association bonds bearing 6 per cent interest. Fifteen thousand two hundred and fifty dollars worth of these bonds were sold, but during the year only $2,000 of this fund was permitted by the directors to be spent on the membership campaign.

In January, 1916, the Secretary asked the approval of the Board to expend $10,000 of this fund to secure new membership. This was objected to on the ground that there was no guarantee that under the existing contract the money so spent would be replaced from net earnings. The matter was dropped. The new President, Mr. Pack, later in the year made a donation of $11,500, and the bonds were retired.

Under this contract the Secretary has very vigorously pushed the work of expanding the membership of the Association, which on January 1, 1921, reached a total of 16,402, a net gain in 1920 of 2,584. The general business principles originally adopted in seeking this expansion were sound and had produced a safe and satisfactory growth. The six years following the adoption of the new contract, while producing this further doubling of the membership, has at the same time wrecked the finances of the Association, undermined its policies and destroyed its

usefulness. The trouble lay, first, in losing sight of the true purpose and character of the Association, and treating it as if it were a private corporation. This involves secrecy and withholding of all information regarding finances from the members. At first the directors were furnished copies of the auditor's report, but since 1917 even this has not been done. Believing that the directors must at least be fully informed as to the finances, the writer in 1915 devised a form of cost accounting statement, and was able to secure from the Secretary the figures for 1915-16-17. On January 15, 1917, Mr. Ridsdale wrote him as follows:

"In reference to the financial statement, Mr. Pack writes to Mr. Quincy:

"'I quite agree with you about not making public the details of our annual statement. This matter has caused me considerable concern and I am indeed glad that you feel as you do about it. We are conducting *a business* and we should not let the secrets of that business become known to everybody. I happen to know that there are certain people that are very curious at this time.'

"Mr. Pack, I take it, and Mr. Quincy both consider this financial statement as a report of the Finance Committee, only to be read to the Directors at our annual Directors' meeting, where they have the opportunity of asking any questions they desire.

(Signed) P. S. RIDSDALE, *Secretary*."

Through the Treasurer, J. E. Jenks, of Washington, well known as publisher of the *Army and Navy Register*, it was possible to obtain the 1918 statement—but Mr. Jenks found a disposition on the part of the Secretary to withhold all information possible even from him. The full statement for the year 1920 has never even been submitted to the Board of Directors. An abstract from this statement was published in the March number of *American Forestry* in compliance with the mandatory by-law adopted in January, 1920.

When the Treasurer, Mr. Jenks, who had been unanimously elected at the meeting in New York in January, 1920, asked the Secretary for the 1919 statement, some time in February, he was informed by the Secretary that he was no longer Treasurer. The Board, on February 20, declared the office vacant and elected Mr. Quincy to be Treasurer. I requested information of the new Treasurer, Mr. Quincy, as to Mr. Ridsdale's commissions and was referred by him to Mr. Ridsdale.

A brief summary of the finances during these years follows:

Year	Membership at end of year, Dec. 31	Net assets	Donations by C. L. Pack	Operating income from members and advertising	Bequests and other donations	Operating profit or loss	P. S. Ridsdale salary and commissions
1915	8,844	$17,705.80	....	$32,981.72	$5,060.00	$ 45.20b	$ 6,919.77
1916	13,750	25,383.73	$12,656.60	50,067.39	2,718.33	6,378.50	7,706.43
1917	15,195	23,286.32	....	51,874.55	....	2,417.00b	10,243.77
1918	14,857	24,405.02	....	44,668.15	....	596.08	9,175.98
1919	13,918	24,704.81	500.00	55,724.80a	639.38	1,550.08b	9,350.08
1920	16,402	18,495.31	19,689.09	67,005.57	5,603.51	11,922.72b	13,177.17

a $7,734.90 from fire adjustment.
b Loss. If an item of $4,874.10 for 1921 dues paid in advance, which has apparently been credited in operating income for 1920, is deducted, this operating loss for the year 1920 becomes $16,796.82.

During the war, Charles Lathrop Pack raised and contributed large sums to an advertising campaign in connection with war gardens, distributing millions of posters and literature bearing his name, and in this work the Secretary of the American Forestry Association co-operated, devoting a portion of his time, and receiving additional compensation from Mr. Pack personally. After the war, Mr. Pack retained this organization for publicity which he had built up, under Mr. Edwards, his personal publicity agent, and turned its energies to securing publicity for forestry, his own name continuing to appear fre.-quently. To this end he expended, in 1919, the sum of $10,595. This account was not handled by the American Forestry Association.

In 1920, Mr. Pack consolidated this publicity work with the American Forestry Association, donating the money and placing the account on the books. He contributed to the Association in this year, $19,-689.09, of which $8,539.86 was spent in continuing this publicity, the remainder to defray the cost of supplying new members with the magazine for the first year.

On December 31, 1919, the five-year contract with the Secretary expired, and the subject of its renewal was not acted on by the Board, nor was the question of compensation presented to or raised by the Board members who attended the Directors' meeting on December 16, 1919, or on February 4, 1920, at which latter meeting Mr. Ridsdale was re-appointed Secretary, nor at any previous or subsequent meeting during these two years. The Secretary, however, received for 1920 his salary and commissions on the same terms as under the old contract, which, it has since transpired, was renewed by the Finance Com-

mittee on November 19, 1919. This committee, consisting of Directors Quincy, Sterling, and Lyman, was re-appointed by the President on February 4, 1920, but was not given any authority by the Board at that time nor subsequently, to act in the matter of determining the Secretary's compensation. The only authority which they could have assumed was vested in them would date back to January 10, 1915, at which time C. F. Quincy was authorized to sign the contract for the Directors. Since this date, the Board has never been consulted regarding Mr. Ridsdale's contract or the terms of his employment. The previous contract executed on October 29, 1912, was signed by 12 directors.

The effect of the operation of these arrangements, of which the Board remained in ignorance, will now be shown. The operating income exclusive of advertising, which is treated separately below, was increased during the year from $42,110.60 to $54,653.56, a gain of $12,542.96. The deduction of the item of $4,874.10 dues for 1921 paid in advance, would reduce this net gain to $7,668.86. The net operating loss for the year was, however, $11,922.72, and the loss after crediting receipts of $5,613.51 from two bequests, which were expended during the year for current expenses, remaining as $6,209.50

The total loss however would be increased to $16,796.82 and $11,083.60, respectively, since it is necessary to make correction for advance payments of dues for 1921.

This anomaly may be explained by examining in more detail the character of the expenditures, bearing in mind that for every dollar f additional operating income obtained, at no matter how great an outlay, the Secretary under his contract secures 20 per cent.

Funds received by the Association in the form of bequests are excluded by the terms of the contract from the sources of income on which the Secretary can draw commissions. These bequests, received since January 1, 1915, are as follows:

1915—Elizabeth Shippen	$5,000.00
1916—Rose Hollingsworth	500.00
1919-20—James C. Horgan	38.56[a]
" John D. Williams French	5,727.68
	$11,266.24

[a] In process of settlement.

But neither the Board nor the Finance Committee took definite action during these years, as was done with reference to life member-

ships, to set these funds aside as capital assets and use only the interest; hence it was possible for the Secretary to immediately expend these funds in campaigns to increase the membership and gross income, which he did, and in this way, from the money thus brought in, his commissions were obtained on what practically was equivalent to a part of these bequests.

The result of this campaign to increase the gross income during 1920 is as follows, taken from the report submitted by the Secretary to the Directors on January 13, 1921. The commission of $3,451.80 constitutes only that portion of the Secretary's total commissions which he received from the income from these new members.

Expended to secure new members		$23,834.15	
Total received from new members	$20,859.00		
Less $3,600 for permanent life membership fund	3,600.00		
Operating income received from new members	$17,259.00		
Less 20 per cent commissions to Secretary	3 451.80		
Net operating income from new members		$13,807.20	
Net loss for year on new membership campaign			$10,026.95

Thus the net income from new members, unless the permanent life membership fund is expended, equalled but 57 per cent of the money expended in soliciting new members. This loss of $10,026.95 had to be met, either from the surplus of the Association or by donation, leaving nothing from which to supply the magazine for one year to these new members as an additional expense. That portion of Mr. Pack's donation not expended for publicity went to meet this latter cost item, leaving the deficit in the campaign for new members as a charge to be met by depleting the capital of the Association.

This apparent loss might later be turned into a profit provided the new members were retained over a period of years, and provided the cost of running the Association were kept below the income received from members. The history of all magazines is one of constant effort to replace lapsing subscriptions. The American Forestry membership, by contrast, are appealed to by the Secretary to retain their connection with the Association on the basis of the service thus rendered to the cause of forestry in America. This has been influential to a great extent in inducing members to continue their connection with the Association. The future as well as the past financial success of the Association rests primarily upon its members, and upon their loyalty

to the cause of forestry. This appeal must rest upon an absolutely sincere and honest basis, and if used solely as a business asset would constitute a base betrayal of the fine spirit of public service shown by the members of our Association.

This question of expenditure for the purpose of expansion has constituted at all times the greatest problem in financing this Association. The Secretary, in reporting the result of his campaigns for members, was in the habit, until last year, of presenting to the Board statements showing the income resulting from outlay for members, without considering the other expense attached, as indicated, namely, his commissions, and the cost of service for one year. If the campaign produced income equal to outlay it was considered a success. Without disputing this assumption, it was evident that the real financial stability of the Association and its ability to continue to exist independent of heavy donations, carrying with them an undue measure of control over policy and management, rested on two things, first, the retention of the new members thus obtained, second, economy in running the Association, so that a certain surplus would be available from each $3 payment, to devote to this campaign.

In order to bring out these facts, avoid dissipating the invested funds of the Association in campaigns for members to increase gross income, and protect its financial, economic and political independence, the writer early in 1916 devised a method of analyzing the costs of running this Association. This analysis was based on the $3 member as a unit, after crediting other sources of revenue against certain definite expenses.

The costs so analyzed for the five years preceding 1920 are shown in the following table.

Comparative Yearly Costs Per Item of $3 Membership

	1915	1916	1917	1918	1919
Cost of magazine production, net	1.384	1.130	1.245	1.542	1.648
Office operating costs, net......	.925	.598	.520	.605	.405
Meetings, campaigns, etc......	.197	.051	.135	.006	.052
Cost of replacing $3 members.	.385	.201	.283	.052	.489
Cost of replacing $1, $10 and $25 members................	.033	.040	.040	.006	.118
Cost of securing new (net) members	.315	.413	.297	.....	.....
Secretary's commission on membership payments.......	.179	.138	.307	.320	.250
Unpaid dues..................		.197	.379	.450	.194
	3.418	2.768	3.206	2.981	3.156
Total cost of securing new members	.315	.413	.297	.058	.607
Net bequests and donations...	.....	.....	.....	.....	.106

The 1920 cost figures are held up pending the determination of certain facts with regard to the crediting of dues paid in advance and their effect upon commissions for 1920. Since this table was compiled, it has been definitely ascertained that one of two things took place in 1920; either the item of $4,874.10 was entered as operating income for 1920, or else the Secretary collected in that year over 99 per cent of the total possible income from all securities. That the former assumption is probably correct is indicated by the fact that for $10.00 members the sum collected in 1920 considerably exceeds the total possible sum representing $10.00 dues from this class of members.

The figures for all years are taken direct from the audit of R. G. Rankin & Company and are believed to correctly represent the pro rata expenses of the Association for $3 members. Those of 1915, 1916, and 1917 were prepared by the Secretary, and those for 1918, 1919 and 1920 by the writer without the Secretary's cooperation.

This cost accounting was really an effort to point out to the Directors the effect of a continuance of the new contract and the need for its modification. In his report Mr. Chapman stated, "As pointed out there must be an operating margin per member, expendable for replacements, plus funds for expansion. The more of these latter funds are derived from net operating income, the more secure the progress. If no such margin ever becomes available, then by constant drain on its invested funds the Association would become bankrupt by the increase in its operating costs."

Under the operation of this contract and in spite of the increase in current income shown, the invested funds of the Association became practically exhausted in the year 1920, and the condition of financial parasitism, which had been foreseen and warned against, was precipitated and fastened upon the Association, and this condition was then made the basis of the arguments for abandoning the old democratic by-laws in favor of the present autocratic control.

The gross income from advertising was increased to $12,040.81 in 1920, but the net to the Association was but $5,247.44 out of which must come the cost of printing the advertisements. The remaining $6,793.37 went to agents or expense, of which the Secretary received $1,799.08. At least one agent was employed by Mr. Ridsdale to solicit advertising on a strictly commission basis of 20 per cent, with no salary, the Secretary receiving an additional 20 per cent of the net sum thus raised, equivalent to 16 per cent of the gross before deducting agent's commissions.

This contract did not hold any inducement to economy or efficiency in business management, but stimulated effort to bring in additional gross income regardless of expense.

That there has been an excessive amount of waste and inefficiency in the membership campaign is evident by many instances in which members of years standing have been repeatedly solicited to join the Association, and their explanations ignored—resignations have been given no attention and the ex-members repeatedly requested to pay up, and other business letters received from members handled apparently in a routine way by inexperienced office help. A large force of stenographers and clerks was employed at liberal wages and apparently without adequate supervision. This condition has operated largely to increase the number of resignations and general dissatisfaction and to increase the turnover and operating expenses.

These facts should be taken into consideration before deciding that the alarming deficit in operating expenses in 1920 was due wholly to business conditions beyond the control of the Association. At best, the choice for 1920 lay between rigid economy in operation with continued financial independence, and lavish outlay, looking to the beneficence of the President and others to effect a rescue. The interest of the members indicated the first course—that of the Secretary, the second.

At the end of this disastrous year of 1920 the net assets of the Association on the balance sheet stood at $18,495.31. Of this sum, $5,000, constituting the Jane Smith bequest was protected by the terms of the will so that only the interest could be spent leaving $13,495.31. But the life membership permanent fund called for the sum of $17,733.73 contributed by these life members.

On January 14, 1914, the Board voted "That life membership receipts in the future shall be used as a capital asset only and shall be placed at the disposal of the finance committee for investment in the best interests of the Association." Up to the year 1920, only the interest on these funds was expended.

The total trust funds, by this action, amounted on January 1, 1921, to $22,733.73 Against this there stood on the balance sheet the sum of $18,495.31. But unfortunately the securities representing these funds were shown on this balance at their cost value or purchase price. On January 1, 1921, the market value of these securities had shrunk

from the purchase price of $25,270.30 to a market value of $16,417.50, a loss of $9,852.80. This leaves a net market value of all assets on this date, of $8,642.51 of which $5,000 cannot be expended, leaving the actual cost value of $3,642.51 of the life membership fund of $17,733.73 intact, or a difference in this fund of $14,091.22. A portion of this value will probably be regained should these securities rise in price, but some, at least, as for instance, one $1,000 bond of the Russian government may be considered lost.

In order to meet these deficits the executive committee on October 14, 1920, voted to approve a transfer of $7,000 from these trust funds, to current incomes *which transfer had already been made as follows:*

June	30,	$1,000
Sept.	30,	6,000
		$7,000

and also voted to raise the annual dues from $3 to $4 *an act which required amendment of the by-laws in an annual meeting.* Bills were sent out in December, 1920, for $4 for the year 1921.

On November 4, 1920, the minutes of the executive committee meeting of October 14 of that year were read and approved by the Board of Directors. This action was probably intended to repeal the vote of the Board taken on January 14, 1914, the Secretary having stated that according to the minutes of the meeting providing for the disposition of the *sinking fund*, the money could be used in this manner. Since the sinking fund, which was to provide for cancelling the bonds, and the life membership fund, were entirely separate, and the Board had never voted to repeal their former action, they probably acted in ignorance of the true status of this life membership fund in confirming this action of the executive committee. The measure had been approved by Mr. Pack on October 15.

The sinking fund ceased to exist on cancellation of the bonds, and it would appear that these facts were not understood either by the executive committee nor by the Board in thus voting to expend what had been set aside as capital funds for a definite purpose in 1914.

On February 25 the annual meeting voted to amend the by-laws by which the price of the magazine should be $4. No financial statement was read or available at this meeting.

The March number of the magazine in compliance with the mandatory by-law adopted by the members the previous year, which required the publication in *American Forestry* of an annual financial statement, contained a brief synopsis of the auditor's report, which did not show the statement of assets and liabilities, the expenditure of the life membership funds, or the difference or shrinkage between lost price and market value of securities. The statement also omitted such detailed items as the commissions received by the Secretary, and the cost of the annual meeting at New York on January 13, 1920, which was $769.09.

On January 13, at a Board meeting, in considering a draft of the new by-laws, the provision adopted in 1920 requiring publication of the financial statement was retained. But on February 20, five days previous to the annual meeting, the final draft of these by-laws, which had been drawn up by the Secretary, acting with Director Pratt, was found to have been modified so as to omit this provision. On February 25, at the Board meeting at 10 a.m., one of the directors insisted that it be restored, and the other directors present, Pack, Lyman, Chard, Sterling, and Drinker, after voicing objections to this measure, finally agreed to do so.

Whether the report as printed is satisfactory to the members is for them to say.

PART IV—THE FRUITS OF THE NEW FINANCIAL ARRANGEMENT

In explaining what now took place, the overwhelming influence of the Executive Secretary in determining the policies adopted, with or without the sanction of the directors, in managing the Association, supplies the missing links. An association is very much in the hands of its paid executive, unless every care is exercised to maintain rigidly the safeguards of regular constitutional procedure. The Secretary has not favored the policy of publication of the details of the financial status of the Association. In this policy he first found support from Mr. Quincy, and later from Mr. Pack. The efforts of the writer to secure and systematize the itemized cost-keeping statement were a source of great uneasiness, though the Secretary scrupulously complied at all times with the instructions of the Board and requests of the Directors. After 1917 this cost accounting was discontinued. It was never accepted or used by the Board.

The Secretary's magazine policy was intended to increase the membership, by improving the quality of the magazine, with illustrations

and popular articles, following the plan of the *National Geographic Magazine.* The tremendous field of usefulness of the magazine for furthering forestry was recognized by directors and foresters alike. The latter, however, as a class, felt that popularity alone was not sufficient, and that purpose and constructive policy were needed to justify the magazine. During 1916 and 1917, up to October of that year, the writer contributed anonymously practically all the editorials published in the magazine. With his employment during the war as a member of the U. S. Forest Service, he was forced to discontinue these contributions and the editorial policy dwindled and in 1918 ceased altogether. In the opinion of many foresters the magazine and association during these years ceased to stand for any real forest policy. In 1918 the practice of holding an annual meeting at which papers and discussions of forestry topics were held, was permanently abandoned. The business meeting advertised that year failed to draw a quorum, and in 1919 none was arranged for.

A widespread dissatisfaction with the apparent lack of purpose and policy of the Association found expression among foresters in the summer of 1919, which led to a protest voiced first by Mr. Elwood Wilson and Prof. J. W. Toumey at Boston in February and later, in July, by the Association of Eastern Foresters, and an attempt by Director Gaskill to arrange for closer co-operation with the foresters and a new slate for directors, in co-operation with Mr. Pack. The entire Board came up for re-election, owing to the holding over of officers due to lapse of meetings for two previous years. But in arranging for this meeting Mr. Pack made his own plans, selected his own nominating committee several weeks in advance of the meeting, and picked his own slate for directors.

When these facts became known, as they did, to some members of the Association about two weeks before the meeting, they organized an opposition ticket to prevent the Association from falling completely and finally into the hands of Mr. Pack. Mr. Gaskill, who felt that Mr. Pack should be re-elected and was unaware of his intended refusal to consult the Board or the members as to directors, on the other hand did not know of this opposition. He was elected a director on the Pack slate but on March 2, 1920, decided not to accept election, in protest against the management of the Association.

That this election was literally the last chance for the members to have any further voice in the affairs of this great and historic association was fully realized beforehand. The fact which recently came to light that in November of 1919 the Finance Committee had sanctioned the renewal of the contract with the Secretary for the next five years, without the knowledge of the Board is furher confirmation of this condition. The personal interest of the President and the Executive Secretary had become so great that it was surmised they would use their possession of the list of members to secure the attendance of as many persons as necessary to out-vote any opposition anticipated.

Fifty-five members, all of long standing and interested in rescuing the Association from autocratic domination, attended the New York meeting in January, 1920, and voted in opposition to the President. Seventy votes were mustered for the slate of the President's selection, which was elected. Directors Greeley and Chapman and Treasurer J. E. Jenks voted in opposition. The former two, however, had also been placed on the Pack ticket and were elected to serve two years. Mr. Jenks was on both slates as Treasurer, and was unanimously elected, but was not included on the winning slate as a director.

Most of those voting for the President's slate left soon after casting their votes. The by-laws were then presented, and acted upon by those that remained, and a clause was adopted providing that the financial statement must be published annually. Under this mandatory by-law, the statement finally appeared in the March issue in the condensed form described in Part III.

At the next Directors' meeting on February 4, it was announced that owing to the change made in the by-laws, requiring the Treasurer to be a member of the Board, it was impossible for Mr. Jenks to serve, as the change had been made before the election was held. This ruling was obtained by Secretary Ridsdale from a lawyer, on the basis that the votes were still being counted and the result had not yet been announced when the change was made in the by-laws. The purpose of this change was to conform to a practice which had been followed previously for over ten years. But the failure of those whose slate was elected to place the nominee for treasurer on this slate as a director was later, as shown, made the basis of his being dropped as treasurer on this technicality. At the Board meeting on February 4, Mr. Quincy was made Treasurer of the Association. The President

before adjourning announced that thirteen *foresters* had voted at the meeting without being members of the Association, and made further remarks derogatory to the foresters as countenancing illegal methods. The writer, being at this Board meeting, later obtained from the Secretary the thirteen names which he had given to the President of those whose votes were questioned, and by correspondence secured nine cancelled checks showing these members to have been paid up and in good standing at the date of the meeting. Two had sent currency which was lost somewhere in transit, one was in arrears in dues and one had mistaken the Association for the Society of American Foresters, which met in New York next day. The Secretary later verified these facts from his records. This misstatement was never formally corrected by the President. Before discovering that his own office records were at fault, the Secretary had informed at least one person, Charles P. Wilber, of Trenton, N. J., not a member of the Board, that certain foresters had voted in this irregular manner. This statement, if accepted as correct, and repeated to others, tended to throw discredit upon foresters as a class.

On December 16, 1920, a meeting of the Directors was held in New York at which a plan was proposed by Director A. D. Pratt of changing the by-laws so as to constitute the Board of fifteen as a self-perpetuating governing body of life tenure, and power to elect the officers and amend the by-laws.

The reasons given were that the Association was losing money, that a large sum of money was available and could be secured by Mr. Pack for the purpose of purchasing a permanent home at 1214 Sixteenth Street, N.W., Washington, that further sums could be secured for endowment, but that the condition attaching to those gifts was that the Board must be so constituted that all possibility of a turn-over or change of complexion by annual election should be removed, and finally, that an indefensible effort had been made at the meeting in January, 1920, to wrest control of the Association from Mr. Pack, a repetition of which must be prevented at all costs. These arguments were placed before the members on March 1 in a mailed circular as the justification for the reorganization effected on April 25.

Mr. Greeley, approached on the preceding day, December 15, 1920, had registered a violent protest. The writer, informed at the meeting on December 16, 1920, seconded this protest. The plan was then sug-

gested by W. R. Brown that eight out of the fifteen directors be elected, leaving seven as permanent life members. The matter was postponed to January 13, 1921, with the writer added to the committee. At this subsequent meeting, he brought in a minority report in favor of a board, none of whom should be life members but all elected, as before. After again emphasizing the financial condition of the Association the directors present including C. F. Quincy, Chester Lyman, H. S. Drinker, W. R. Brown, A. D. Pratt, Nelson C. Brown, and Standish Chard, expressed themselves in favor of the Brown plan. Mr. N. C. Brown stated that in his opinion the foresters were all in hearty sympathy with and solidly behind the Association. The writer stated that for ten years he had endeavored to secure two main objects, namely, the support of the foresters for the Association, and a sound financial policy, he had been even *too* active in the latter question, and that he had endeavored as far as possible to work constructively with the Board rather than be constantly in the position of a kicking minority. As to the present plan he had said all he could against it and would rest his case.

Messrs. Pack, Quincy, and Lyman then suggested that the names of the seven life directors must be mentioned in the new by-laws, and that the writer should be included. The meeting then edjourned.

The names published on page 120 of the February issue of *American Forestry*, and which were elected on February 25, for life, are, W. R. Brown, of the Brown Company, Berlin Mills, New Hampshire; H. H. Chapman; Henry S. Drinker; C. W. Lyman, Vice-President of the International Paper Company; Charles Lathrop Pack; Charles F. Quincy; and Ernest A. Sterling, now connected with John D. Lacey & Company, Timber Brokers.

Following the Directors' meeting on January 13, the writer was advised to accept the nomination as life director by those men he consulted, four or five in number, and permitted his name to remain on the list. It was recognized by all, whatever their sentiments, that it would be impossible to prevent the officers of the Association from securing the attendance of enough persons at Washington to carry this election and put through the plan.

But within a few days of the meeting, additional and very serious facts came to light regarding the financial conduct of the Association, and the final draft of the by-laws was found to have been modified in

several important details, by which an executive committee of seven would control the Association and the financial reports would not be published. It was determined by a few members of the Association that an effort should be made to secure a referendum vote of the 16,000 members on these by-laws. About fifteen members attended the meeting to act as spokesmen for those who protested the proposed action. The account of the meeting was printed in the March issue of the JOURNAL.

To sum up the case.

Of the seven men, who by this action are made life directors, not responsible in any way to the members for re-election or for their policies, Directors W. R. Brown, E. A. Sterling, and Chester W. Lyman are each of them so closely affiliated with large business interests in timber and timber lands, and Mr. Pack has been so directly concerned with lumbering in the past, that they cannot be expected to prefer the public interests in legislation to their own interests, much as they would like to do the fair thing.

Dr. Drinker was retained on the Board by Mr. Pack after and in spite of his record with respect to national forest policy and Mr. Pack's public repudiation of his attitude. This was due, I think, to the Secretary's close personal friendship for Dr. Drinker. He finally became one of the life directors.

Mr. Pack at the time when his election for President was being discussed, in December, 1915, was objected to by Mr. Quincy on the ground that if he ever became President he'd put the Association in his pocket and walk off with it. But Mr. Quincy later became a close supporter of Mr. Pack probably because of his generosity in aiding in the building up of the Association's finances, and their agreement as to the financial policies which should be followed in its management.

Had the Secretary been willing to confine his efforts to his legitimate field and not sought complete domination of the organization, he could have secured adequate assistance which would have handled the questions of policy in an efficient manner. Such assistance was freely given whenever requested. It was beyond his powers to handle both the policy and the finances.

Had the President not proceeded on the principle that his financial contributions entitled him to manage the Association without any serious interference from the Board of Directors, the events might

not have occurred which led him to sanction the proceedings of February 25.

Had the directors chosen for life reposed greater confidence in the common sense and good judgment of the members of the Association, they would not have felt justified in consenting to take its direction out of their hands.

Had Mr. Pack realized that the few individuals, not over 25 in number, who protested his rulings and asked for a referendum to the members on February 25, really and in truth represented these members, he would not have enjoyed his personal triumph, nor the congratulations of his supporters after the meeting, with so keen a relish.

The American Forestry Association belongs to no one man or group of men, but to the members and to the public, who I am confident will liberally finance it if and when they are assured that it is above the suspicion of insincerity and hypocrisy. Which is best? For the 16,000 members to resign, or for the present officers to retire and restore the control of the Association to its members? As for the property and the endowment, the contract has I understand been carried out, and the price paid. The Association I believe now owns the house at 1214 Sixteenth Street, worth $45,000.[1] Other funds are promised. It may even be that sufficient money will be forthcoming to employ the field agent so long talked of and never materializing "because, what if after we raised the money to employ this man, the Association should be captured by a bunch of radicals, and the agent be used to promulgate the doctrines of Gifford Pinchot?"

"What doth it profit an Association to gain the whole world and lose its own soul?"

Back of the entire question of business control of the American Forestry Association lies the real but intangible desire or object of controlling the means of expressing public opinion.

It will be of interest to the readers of the Journal of Forestry to know that President Pack has had for several years a project of securing the printing of the Journal, by the American Forestry Association, and of aiding liberally in its finances. After the meeting last January this project, in the words of Mr. Pack, was postponed, "as the time was not ripe."

[1] Later information is to the effect that this property is held presumably by the Secretary and has not yet been donated to the Association.

At the present time I believe it is fortunate for the JOURNAL that Mr. Pack and the American Forestry Association are in no way connected with the publication or financing of the JOURNAL OF FORESTRY, and that there exists one organ whose utterances cannot be silenced even by threats of libel.

PART V—THE PRESENT BOARD OF DIRECTORS—WHO THEY ARE AND WHAT THEY REPRESENT

The great need in forestry in this country for the past decade, greater today than ever before, is popular education in sound forest economics, and vigorous efforts to enact these economic principles into a practical forest code. For this purpose the American Forestry Association by its history and character was eminently fitted. But to fulfill this function required a board of directors working disinterestedly for the public good, a clear understanding of forest economics on the part of the directors and officers, a magazine in which first place was given to the furtherance of sound legislation, and a field secretary or agent of proved ability, to devote his entire time to legislative campaigns in the nation and the states.

Instead, we find an Association with a gross income of $100,000 unable to afford a field secretary, a magazine in which the discussion of sound forest policy is conspicuous by its absence, a Board many of whom have displayed remarkable misunderstanding or lack of understanding of the principles of forest economics and some who have openly expressed their disbelief in practical forestry, their fear of possible measures of forest regulation and their distrust of foresters in Government and State employ when it comes to interpreting these measures, and an Association which has been conspicuous chiefly for weakness and vacillation in supporting any public measures, and whose Secretary and Board of Directors are in principle opposed to having the Association commit itself on any public issue about which there is a difference of opinion, or which can be construed as "politics."

We find this Association conducted in a manner which has progressively deprived its duly elected Board of Directors of their powers of supervision and management over its finances and policy, concentrating this power in the hands of the Executive Secretary employed by the Association, acting through the President and the Chairman of the Finance Committee. We find this Secretary's suggestions adopted

and enacted in some instances without reference to either the Executive Committee or the Board. We find certain members of the Board deprived of their functions on committees and on the magazine by the simple method of ignoring them. We find the constitutional safeguards protecting the nomination and election of Directors by the members progressively broken down and swept aside until at the final election on February 25 no pretence was made of concealment but a slate of Directors was presented by the Board itself in printed form, without appointing a nominating committee. We find the idea that money, and not democracy, has the right to dictate the management and policies of the Association, a principle which strikes at the foundations of the republic, and jeopardizes the entire future economic life of this nation so far as it is dependent on future wood supplies, and finally we find this entire program dressed up in sheep's clothing and sent out, at the expense of the Association, to its members, as a great forward step in forestry, as a measure necessitated to free the Association from control by special interests, and as an assurance to those who desire to aid in its work through substantial financial support. "The Association is therefore now in a position to do more to promote forestry than ever before. It will continue *unhampered* its policy of truly representing the public! It will further its educational work to the limit of its resources. It will strive to greatly increase its membership, to extend its influence, to secure greater prestige, and to advance the whole cause of forestry in every way its capacity permits."

This result is to be accomplished first by driving all the remaining foresters out of the Association, since they constitute a special interest which has sought to control it, and are incapable of understanding the problems of running such an association or the art of publicity. The American public and American forestry must be protected against foresters. Men like Bernard E. Fernow, Gifford Pinchot, Henry S. Graves, William B. Greeley, Fellows of the Society of American Foresters, are to be guarded against, and as for H. H. Chapman, elected as a life director, and then basely turning against his benefactors, the less said the better. Should the JOURNAL OF FORESTRY be so bold as to print any material reflecting upon the present management of the Association, its editor is discreetly informed over the telephone, without witnesses, that a libel suit will be instituted. Foresters are easily intimidated and do not know their own minds. They also lack the money

and influence to make their protests effective, and the utterances of the JOURNAL OF FORESTRY are disregarded since it has a circulation of but 600.

THE FIELD SECRETARY

The need of a field secretary was recognized from the start, and was advocated by various board members, notably Mr. Quincy and Mr. Brown. Mr. Ridsdale always expressed his approval and even enthusiasm for this field secretary, but the money never was available with which to employ him.

In 1917 Mr. Ridsdale was authorized to employ an assistant, and engaged a young forestry graduate from Syracuse, C. W. H. Douglass, whom he employed in soliciting advertising. This forester enlisted and was killed in the war.

In this same year the pressure to engage a field secretary was met by a proposal by the President to raise a fund of $20,000 to finance such an undertaking outside of the funds of the Association. Eleven thousand dollars was pledged, but the fund was not completed, and the matter was soon dropped. The place and functions of this field agent were filled by the publicity agent, Mr. Edwards, previously mentioned, and who is now on the roll of the Association supported by donations from the President. He has done good work for the Association.

Whether or not the Secretary was actually favorable or opposed to such division of responsibility as would result from the employment of an able field man by the Association is not for me to say.

THE MAGAZINE AND POLICY

The improvement and excellence of the magazine as such reflects the best phase of the Secretary's ability and has met with nothing but praise. The failure of the magazine lay in the absence of a consistent, vigorous, and sound policy. The fault here lay primarily with the Board, since the Secretary dare not publish anything without the approval, at least, of those whom he looked to for the direction of the Association's affairs. As Mr. Chapman was a director, Mr. Ridsdale, during 1916 and 1917, accepted and published the editorials he contributed. After the meeting in January, 1920, at which the Board was nearly defeated for re-election, the Secretary, by co-operation of Director Greeley, en-

gaged Mr. S. T. Dana to prepare the editorials, which service was then resumed after a two years' break, and continued until March, 1921, when Mr. Dana delined to act in this capacity any longer. No desire was ever expressed to deprive the Secretary of credit for these editorials written by others, as the service was for forestry.

That this fundamental weakness of position was due to the Board members is evident, for Mr. Ridsdale in one sense is an exemplary executive in that he scrupulously carries out instructions and takes no risks of publishing anything which would meet with the disapproval of the Board.

What do these Board members stand for in American forest policy?

Charles Lathrop Pack was president for many years of the Pack Woods Company of Michigan, and was for 25 years one of the largest manufacturers of lumber in this country. According to the Bureau of Corporation's report on timber published in 1913-14, he was then one of the largest owners of pine timber in this country. Mr. Pack bought vast quantities of longleaf pine situated in Mississippi and Louisiana in 1882 to 1885, at a price of $1.25 per acre for timber and land. This pine, running from 10,000 to 30,000 board feet per acre, increased in value on the stump to from $5 to $7 per thousand feet, or a value per acre of from $50 to $200. The cutting methods employed in stripping this long-leaf timber from Mr. Pack's lands as witnessed in the vicinity of Jena, Winn Parish, Louisiana, and photographed by me, constitute the worst examples of complete forest denudation in the South and cannot be exceeded in complete destructiveness anywhere in the United States. So bad has this condition become in the South that the State of Louisiana in the Spring of 1920 passed a law, the first of its kind in America, compelling such operators to leave seed trees, at the time of logging, in order to provide for reforestation. This practical and simple measure Mr. Pack had no hand in advocating, nor did the American Forestry Association lend any support in the passage of this bill. During the present spring, a similar bill proposed in Texas was defeated by the lumbermen of that State in the legislature, the American Forestry Association taking no part to assist the State Forester to secure his conservation measure, which is a practical application of the principles of the Snell Bill for which the Association is supposed to stand.

Mr. Pack has stated in Board meeting that if there were even a possibility of getting back the principle of any money invested in forestry, there would be some excuse for lumbermen to practice it, but that up to that time such was not the case. He also stated in 1921 at a Board meeting that the parties from whom he expected to obtain the endowment to apply on employing a forester as field agent, expressed the fear that unless provision were made to perpetuate the present Board of Directors by creating life terms, this money might be ultimately used to employ a man who would spread the revolutionary doctrines of Gifford Pinchot.

Mr. Pack is probably sincere in believing that the general public is interested in Memorial Trees, Roads of Remembrance, The Forest Poetic, and even in Fire Prevention and other forward steps which call for public expenditures. He did not commit himself on the Snell Bill, however, until satisfied that the measure had the united support of the large associations of lumbermen throughout the country, after which the American Forestry Association actively took up publicity in its behalf. Mr. Pack is a life director.

W. R. Brown is an officer and owner in the Brown Corporation of Berlin Mills, N. H., which owns enormous areas of spruce and balsam timber in New England and especially in Canada, and is engaged in logging these lands and in paper manufacturing. Mr. Brown's interest in forestry is genuine and practical. As a member of the New Hampshire Forestry Commission for over ten years he has done great service in promoting fire protection in that State and is an expert on fire insurance for standing timber. Mr. Brown, however, distrusts the wisdom and ability of public officials in administering any legislation of a mandatory character having to do with brush disposal or restrictions on cutting.

His views are, that whatever the forest owner does toward securing forest conditions, on his cut-over lands, with the exception of fire protection, must be paid for by the public, "and the American principle of quid pro quo carried out in place of un-American mandatory laws for the restriction of cutting which would be confiscatory in character and should never be worked except as a last resort in the direst emergency." This skepticism leads him in the same article to question the efficiency of the work of the U. S. Forest Service on the National Forests in the words, "Doubts have been expressed . . . that there

has been evolved any settled national policy of cutting or forestation upon them worthy of name," and at a recent Board meeting (December 16, 1920) to reiterate his belief in the doctrine of quid pro quo as against that of exercise of police power of the State, and his uncertainty as to how far and how judiciously Col. Greeley would exercise the very limited powers given to the Forester under the terms of the Snell Bill. He also produced some figures showing that the cost of burning spruce brush was 60 per cent as great as that of logging the timber. Mr. Brown may of course be right in his contentions. My purpose is to indicate his general attitude toward the national forest policy. He is now a life director of the Association. It was Mr. Brown who proposed the substitute plan by which only seven of the fifteen directors be elected for life tenure, instead of, as proposed by Mr. Pack, having all fifteen elected for life. Mr. Brown favored this plan not only for its financial stability but because he held that the Association existed primarily for scientific and educational purposes, which required this kind of an organization, and distinctly not, primarily, for the purpose of agitation for a forest policy.

Chester W. Lyman is Vice-President of the International Paper Company, probably the largest owner of forest lands in New England, with holdings in Canada. His company is actively engaged in logging spruce and other timber and is directly and vitally interested in any legislation affecting the management of these timberlands. Mr. Lyman has been extremely non-committal as to policy, and has never actively supported or upheld the National Forests or public measures, preferring the theory that forestry is best practiced by private owners without interference. Had he and Mr. Quincy as members of the Executive Committee displayed a better grasp of the need for supporting National Forests, it would not have taken three years to get this question by the Execeutive Committee and decided by the Board, during Dr. Drinker's presidency. Mr. Lyman apparently was not hostile to the National Forests, but neither was he enthusiastic about them, and the responsibility for this prolonged vacillation on the fundamental issue of National Forests, after that issue had been won and settled in the minds of the public except for a few reactionaries, must be laid to Mr. Lyman's and Mr. Quincy's support of Dr. Drinker's contentions.

Mr. Lyman is now a life director of the Association.

Henry Sturgis Drinker. In Part I the position which Dr. Drinker took with reference to a policy of continuing our support for National

Forests was briefly set forth, and note was made of Mr. Pack's espousal of the cause and condemnation of Dr. Drinker's attitude. This hostility to the principle of maintaining the National Forests Dr. Drinker expressed publicly, as President of the American Forestry Association, at the University of Illinois, on January 18, 1915, in which he said, "It is dangerous for a man untrained in engineering to venture opinions on questions like conservation of coal in Alaska and the development of waterpowers . . . questions that require the best judgment and experience of trained engineers." Dr. Drinker's attitude on National Forests arose from his correspondence with waterpower engineers in Colorado who were hostile to the National Forests. He reiterated these public utterances on October 20, 1915, at the Panama Pacific Exhibition at San Francisco, saying, "We (the American Forestry Association) are not immune from factional dissentions when such controversial matters as States rights, *National control,* waterpower, and the development of Alaska align our people into different camps who would wish to commit the Association unreservedly to their factional views and are far from satisfied with neutrality." On June 9, 1916, Dr. Drinker speaking before the Berks County Conservation Association at Reading again expressed his disapproval of the retention of the National Forests by the Government in Western States.

In the July issue of *American Forestry* Mr. Pack, discussing Dr. Drinker's defense of a resolution on Public Lands passed by his resolutions committee at the Sixth Conservation Congress, stated, "Two wrongs do not make a right. That it was well to plainly express our faith in the national conservation policy at this time is shown by the large number of letters and messages of approval which I have received from all parts of the country." Mr. Pack's original statement, on page 353 of the June, 1911, issue was written by me and published over his signature.

But on July 5, 1916, Mr. Pack wrote, "I don't think there is anything to be gained by keeping up the fight over Dr. Drinker. He is in some ways a very useful member of the American Forestry Association."

Dr. Drinker's position in opposition to any active stand on legislative questions has been consistently that the Association is a scientific and educational body not engaged in political activities. He has been elected a life director of the Association.

Ernest A. Sterling, formerly a member of the U. S. Forest Service, during his earlier years as a Director, rendered great service to

the Association in helping to formulate its forest policies and combating Dr. Drinker's efforts to nullify or neutralize them. Mr. Sterling has, through his connections with lumbering and lumbermen, steadily become more skeptical and pessimistic regarding the real possibilities of establishing a practical forest policy in America. To the writer he remarked several years ago, "Forestry—there ain't no sech animile." Without a fundamental belief in the possibilities of forestry it is a question how far he would now go in supporting vigorous measures for the establishment of an adequate forest policy. For the past five years he has co-operated closely with the Secretary, Mr. Quincy, and Mr. Pack, and actively aided in securing the re-election of the Pack ticket at New York in January, 1920. But Sterling went so far, at Washington on February 25, as to register his disapproval of the methods by which the autocratic control of the Association was vested in seven directors, by voting for the submission of the question of referendum to the members against the expressed desire of the President.

He was elected as a life director.

Charles F. Quincy is a dealer in railroad specialties in New York. He has never interested himself especially in matters of forest policy, does not pretend to understand them and is frankly interested only in the success of the Association as a commercial enterprise. His interest in forestry is genuine and he believes in the Association's possibilities as an agent for effecting publicity and popular education. He is especially desirous of preventing the Association from falling into the hands of any special interest and was found to be coldly unreceptive to certain advances which were made several years ago through an agent of certain large interests to secure publicity through *American Forestry*. Mr. Quincy regards all propaganda or legislative activity as dangerous for the Association to meddle with. Efforts to secure non-political State forestry organizations are regarded by him as meddling in politics. His neutrality in these matters reinforced Dr. Drinker's efforts, and with Mr. Lyman prevented for three years the remaining twelve members of the Board from getting a final expression of their views on the National Forest question.

Mr. Quincy's great failing is a belief that the financial management of the Association is not the business of the Board of Directors but should be conducted solely by the Finance Committee of which he is chairman, with the President's co-operation. He is responsible with

Mr. Pack for the policy of suppressing the auditor's statements and withholding these facts from the Board, and for the re-employment of the Secretary for 1920 without permitting the Board to determine the terms of his compensation, a principle about which Director Pratt stated on February 21, 1921, "His compensation is a matter which the Board of Directors should certainly fix." He is responsible for the policy, adopted in January, 1915, of adopting a five-year contract with the Secretary whose terms were not revealed to the Board, and later, in 1916, for suppressing the recommendations of a committee consisting of Chapman and Ridsdale for modifying the terms of this contract to read more favorably to the Association. His theory of a Board, where finances are considered, is that of dummy directors, and it has been found practically impossible for any Board member not on the finance committee, to obtain the requisite information from him or from the Secretary, on which to base his knowledge of the affairs of the Association. Mr. Quincy was elected a life director.

The writer was elected as the seventh life director.

Of the other eight directors of whom five were elected on February 25, J. B. White is a well known lumberman of Kansas City, Mo., who has been very much interested in forest conservation everywhere except on his own operations, where it is unfortunately impossible owing to a number of good economic reasons. Nelson C. Brown is a forester, employed by the American Wood Export Association of New York, who has expressed himself both before and since the last election as strongly sympathetic with the policies and methods of the above six life directors.

William B. Greeley, chief of the U. S. Forest Service, formerly a Director, resigned on March 5, 1921, as a protest against the methods employed at the election, and requested his letter of resignation to be published in *American Forestry*.[2]

Standish Chard and Addison S. Pratt are lawyers in New York City, who do not pretend to understand forest policies and were both strongly in favor of the autocratic control of the Association, viewing it as a business corporation solely.

Emerson McMillin is a New York banker, who never attended a Board meeting, but who did protest against the plan of reorganization as undemocratic.

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[2] In place of publishing this protest of Col. Greeley's, the April number of *American Forestry* ran an article on Alaska by him, which was contributed before the annual meeting.

Elbert F. Baldwin and John Hays Hammond are new directors, friends of Charles L. Pack, well known men and excellent additions to the Board. They are welcome for their two-year periods and may be re-elected. Mr. Baldwin is an editor on the *Outlook*, a man of broad vision who sees, as all broad-minded men interested in forestry have seen, the wonderful possibilities of this organization if rightly handled. Mr. Hammond's opinions on forest economics are not known to the writer.

This constitutes, with one vacancy, the Board.

With this Board so constituted, of whom six of the seven life members are incurably reactionary and wish to avoid legislative or controversial questions, while the majority of the remaining eight are either uninformed on policy, reactionary, newly elected, or have resigned in disgust, what prospect has this Association, in the words of its Secretary, for "assuring a continued public service and public-spirited policy" or being "therefore now in a position to do more to promote forestry than ever before?"

A PLAN FOR THE DISPOSAL OF INDIAN RESERVATION TIMBERLANDS [1]

By E. A. Sherman

Associate Forester, U. S. Forest Service

The plan which I propose to present to you for the disposal of Indian Reservation timberlands is not offered with the intimation that it is new, novel, or original. Its essentials were embodied in the report of the Secretary of Agriclulture dated January 23, 1920, submitted to Congress in response to a request from the Chairman of the House Committee on Indian Affairs and in the last three paragraphs of the "Snell Bill." To that extent it becomes one of the important features of the "national program of forestry." My plan merely consists in including with the classification and reservation features of the last three sections of the Snell bill as applied to Indian reservation timber lands, and as partly expressed in the form of bill recommended by the Secretary of Agriculture in his letter of January 23, the specific provisions for valuation and compensation included in the latter measure.

The plan which I propose, therefore, does not contain a single proposition new in itself. It merely combines the better features of two very similar measures. However, neither of these measures has received such full and free discussion as the importance of the question deserves. Their proposal has been overshadowed by other more sharply defined issues. The purpose of this paper is to elaborate and, so far as I am able, bring out the more important details essential to the actual working of the complete plan. The report of the Secretary of Agriculture and the proposed law embodied in that report and, in many features, incorporated in the Snell bill, furnish the working skeleton and driving power; but to get a clear understanding of the proposal it is necessary to give it form and feature. I hope to furnish you a "speaking likeness."

According to the official report of the Commissioner of Indian Affairs for the fiscal year ending June 30, 1920, there were unallotted Indian Reservation timber lands having acreage, volume, value, and location as shown by the following table:

[1] Read before the Washington Section of the Society of American Foresters, February 24, 1921.

Unallotted Timber Lands

State and Reservation	Estimated acreage	Estimated quantity	Estimated total stumpage value
		M feet b.m.	
Arizona	1,247,740	4,296,600	13,780,050
Fort Apache [a]	650,000	1,000,000	3,000,000
Moqui	....	....	....
Navajo	430,000	3,000,000	10,000,000
Pima [a]	25,000	50,000	100,000
Salt River	....	....	....
San Carlos	111,000	221,000	603,250
Sells [a]	....	....	....
Truxton Canon	31,740	25,600	76,800
California	109,050	1,064,050	1,359,356
Campo	50	50	200
Digger	....	....	....
Fort Bidwell	[b] 1,200	[b] 5,000	[b] 25,000
Greenville [c]	....	....	....
Hoopa Valley	83,600	850,000	850,000
Pala	1,700	11,000	16,156
Round Valley	....	....	....
Saboba	2,500	6,000	12,000
Tule River	20,000	192,000	456,000
Idaho	75,709	377,887	1,428,661
Coeur d'Alene	2,629	7,887	23,661
Fort Hall	46,080	100,000	460,000
Fort Lapwai	27,000	270,000	945,000
Iowa: Sac and Fox [a]	500	750	15,000
Minnesota	124,077	65,609	652,693
Fond du Lac	....	....	....
Grand Portage	16,000	1,000	7,000
Leech Lake	....	....	....
Nett Lake	....	....	....
Red Lake	107,677	64,509	645,093
White Earth	400	100	600
Montana	353,341	2,283,800	5,598,800
Blackfeet	44,541	[d] 345,000	640,000
Crow	10,800	24,800	24,800
Flathead	200,000	1,350,000	4,050,000
Fort Belknap	28,000	84,000	164,000
Tongue River	70,000	480,000	720,000
Nevada: Nevada [a]	2,000	3,000	30,000

State and Reservation	Estimated acreage	Estimated quantity	Estimated total stumpage value
		M feet b.m.	
New Mexico	578,753	1,587,500	4,660,000
Jicarilla	205,253	10,000	15,000
Mescalero	250,000	1,500,000	4,500,000
Northern Pueblos	10,000	20,000	60,000
San Juan	12,000	50,000	62,500
Zuni	1,500	7,500	22,500
North Carolina: Cherokee	57,000	35,000	192,000
Oregon	1,107,508	11,225,650	28,026,300
Klamath[c]	752,000	7,520,000	22,560,000
Siletz	3,188	195,000	195,000
Umatilla	2,320	10,650	21,300
Warm Springs	350,000	3,500,000	5,250,000
South Dakota	37,540	20,000	100,000
Lower Brule	....	....	....
Pine Ridge	37,540	20,000	100,000
Utah	11,600	18,000	39,750
Goshute	5,000	3,000	6,000
Uintah and Ouray	6,600	15,000	33,750
Washington	1,292,323	8,340,639	12,192,378
Colville	620,000	1,400,000	1,400,000
Cushman	....	....	....
Neah Bay	20,797	275,000	275,000
Spokane	75,000	543,464	1,086,928
Taholah	226,531	4,345,339	6,451,975
Tulalip	....	....	....
Yakima	350,000	1,776,836	2,878,475
Wisconsin	246,543	994,741	4,635,875
Grand Rapids	....	....	....
Hayward	....	....	....
Keshena	227,180	950,768	4,324,093
Lac du Flambeau	10,594	3,973	31,782
La Pointe	8,769	40,000	280,000
Red Cliff	....	....	....
Wyoming: Shoshone	44,160	334,530	756,038
GRAND TOTAL	5,287,849	30,645,056	73,366,901

[a] Mostly cordwood, fence posts, etc., in this reservation.
[b] School reserve.
[c] On public domain.
[d] Includes ties and posts.

The proposed plan provides first for the temporary withdrawal of all lands in Indian Reservations which are owned by the United States or subject to disposal by the United States, and are chiefly valuable for timber production or watershed protection. Before they can be withdrawn the lands must first be examined by the Secretary of Agriculture and found to be of the class required. This classification must then be approved by the National Forest Reservation Commission. The withdrawal takes effect when the approved classification is filed with the Secretary of the Interior.

As to such lands as are withdrawn because chiefly valuable for timber production or watershed protection the National Forest Reservation Commission has two functions. First, it is authorized to recommend to the President the incorporation within National Forests of any lands so withdrawn; second, to determine the value of any such lands as are the property of Indian tribes, and to provide for the liquidation of the Indians' equities. Upon recommendation of the Commission, the President, in his discretion, may incorporate such lands in the National Forests subject to any valid claims, entries, or allotments, and to the rights, equities, or title of the Indians. Upon inclusion within the National Forests the lands would thereafter be administered by the Forest Service substantially as other National Forest lands, such special provision being made to meet the requirements of their origin exactly as special provisions are made to meet peculiar local conditions upon other National Forests.

Expressed in tabloid form, this plan proposes that all unallotted Indian reservation lands chiefly valuable for timber production or watershed protetion shall be taken over by the Government for that purpose, and that the Indians shall be paid for them.

That lands chiefly valuable for timber production and watershed protection should be reserved for such purposes is an economic truism. The proposition is not one which admits of serious question within this Society.

That the Indians should be treated fairly and not unjustly deprived of their lands is equally true and as freely conceded. It should not be necessary for me to file any disclaimer on the part of the Government of intention to defraud. I feel that honesty of purpose in the recognition of existing equities may at the outset be conceded as inherent in all branches of the Government and not a rare attribute peculiar to some one Bureau alone.

With these two points made clear: (*a*) that lands chiefly valuable for timber production and watershed protection should be permanently

used for such purposes, and (*b*) that the Indians should and shall be treated equitably by the Government, it follows that a number of the larger and more important areas of Indian Reservation timber lands should eventually be included in the National Forests. This does not apply to all Indian Reservation timber lands. To such lands, as a whole, the general principles of the national program of forestry would apply. Allotted timber lands, if non-agricultural, would eventually be acquired by the Government or brought under protection and regulation by the State as the owners achieve competency, the same as all other privately owned lands of similar character. Activities under the plan now being considered would deal first with the larger areas suitable for additions to National Forests. Leaving aside existing legal obstacles for the moment, the areas most suitable for direct accession to the National Forests are shown on the following table:

Possible National Forest Additions

State and Reservation	Estimated acreage	Estimated quantity M feet b.m.
Arizona:		
Apache and San Carlos	721,280	1,221,000
Navajo	430,000	3,000,000
California:		
Hoopa Valley	81,800	850,000
Tule River	28,180	95,000
Idaho: Fort Hall	46,080	100,000
Montana:		
Crow	10,800	24,800
Flathead	390,375	1,350,000
Fort Belknap	28,000	84,000
Tongue River	70,000	480,000
New Merico:		
Jicarilla	205,253	10,000
Mescalere	348,910	1,500,000
North Carolina: Cherokee	57,000	35,000
Oregon:		
Klamath	752,000	7,520,000
Warm Springs	350,000	3,500,000
Washington:		
Colville	620,000	1,400,000
Yakima	350,000	1,776,836
Wyoming: Shoshone	44,160	334,530
TOTALS	4,533,838	23,281,166

With the exception of the Navajo, which in itself is a very doubtful proposition in any event, every other area would probably be merged in and administered in connection with long-established existing National Forests.

The figures given, both for area and volume, are very tentative. In most cases they are taken from the official report already quoted. In some cases they represent the areas at one time included in the National Forests by Executive Order or areas previously recommended for such inclusion in Forest Service boundary reports. In some cases the area exceeds the timbered area reported by the Commissioner. For example, about half of the Flathead area consists of steep slopes, much of it barren, lying between the lower forested slopes and the boundary of the adjoining Forest on the summit of the mountain range, and not included in the timbered acreage in the reports of the Bureau of Indian Affairs.

It will, of course, be understood that the classification recommended by the Department of Agriculture would be based upon careful field work and that the Department would avail itself fully of the data already obtained by the Government.

In this connection the measure which the Committee on Indian Affairs has reported to the House of Representatives providing for the reorganization of the Indian Service is of special interest. As reported to the House January 25, 1921, by Congressman Snyder of New York, Chairman of the Committee, Section 6 of this bill reads as follows:

Sec. 6. That on and after July 1, 1922, there shall be in the Forest Service, in the Department of Agriculture, an Indian Forest Division, to which there is hereby transferred all the authority now exercised and all the duties now performed by the Bureau of Indian Affairs, in the Department of the Interior, with respect to the care and disposal of timber upon Indian Reservations, and there is hereby authorized to be appropriated such sums of money as Congress may from time to time deem necessary for such purposes: *Provided*, That nothing in this section contained shall be construed to authorize an appropriation for new projects or in excess of amounts already specifically authorized for existing projects.

The creation of an Indian Forest Division in the Forest Service of the Department of Agriculture, and the transfer to that Division of all the authority now exercised and all the duties now performed by the Bureau of Indian Affairs, with respect to the care and disposal of

timber upon Indian Reservations, necessarily carries with it as a concomitant the understanding that if this measure is enacted into law one of the results will be that each and every one of the officials of the Bureau of Indian Affairs now primarily and directly engaged in this work will be transferred immediately to the Forest Service, excepting where such transfer is objected to by the Bureau of Indian Affairs or is not acceptable to the officer.

Assuming the accomplishment of such a merger upon a basis not distasteful to the members transferred from the Indian Office, the result should be beneficial to both organizations. The amalgamation of the two organizations in a single Bureau would bring to bear upon the line of work the combined experience, vision, and initiative of both organizations. The old adage that "two heads are better than one" naturally applies here. Furthermore, the larger field organization of the Forest Service in the West would materially strengthen the work at many points on Indian reservation timberlands. At any rate, the proposed measure brings into prominence for early consideration the problem of the future of the forest lands in Indian Reservations.

Upon this point Mr. Snyder's bill presents an anomaly, for the reason that Section 4 of his measure authorizes and directs the Secretary of the Interior to sell, under such rules and regulations as he may prescribe, any surplus of unallotted lands within any Indian Reservation which may be in excess of that required for allotting purposes, where such action will not interfere with the contemplated allotment. This instruction is accompanied by the proviso that it shall not apply to any lands that are cultivated, farmed, or necessary for grazing by any Indian or Indians having rights on the Reservation not in excess of his or their pro rata share. In short, while the measure provides for establishing an Indian Forest Division in the Forest Service, at the same time, it contains instructions which, interpreted literally, would result in the Secretary of the Interior selling all the Indian Reservation timber lands. In view of the questions which this Committee has in the past raised regarding the eventual disposition of forest lands in Indian Reservations, it is believed that the Committee expects that the creation of an Indian Forest Division in the Forest Service would result in the formulation of a plan for the rational disposal of forest lands within the Indian Reservation, while at the same time properly safeguarding the general interests of the public as well as the special interests of the Indians.

The plan for the disposal of Indian reservation timber lands as expressed in the Snell bill and in the report of the Secretary of Agriculture, provides for a classification of such lands. The establishment of an Indian Forest Division in the Forest Service would fit in with this plan admirably. The work would then be done by that Division and the Forest Service's existing Branch of Lands in collaboration.

To become effective such classification must meet with the approval of the National Forest Reservation Commission. This Commission is, as you all know, composed of the Secretary of War, Secretary of the Interior, and Secretary of Agriculture, two Senators appointed by the President of the Senate, and two Representatives appointed by the Speaker of the House. Each of the two leading political parties has usually been given recognition in both House and Senate appointments. Also, there has been representation of North, East, South, and West. The Commission, therefore, is not dominated by any department or any section. Necessarily the relations of the Indian Office with the Secretary of the Interior are as close as the Forest Service with the Secretary of Agriculture. Obviously, the Secretary of War and the Senate and House members should be credited with an attitude of strict impartiality guided by an earnest desire to advance the broad public interests within limits of national integrity.

You have been asked to accept as an economic truism the proposition that Indian Reservation timber lands which are chiefly valuable for timber production and watershed protection should be administered as timber reservations. It is believed your judgment will also readily concede that such areas of such land as may readily be merged with existing National Forests may be most effectively and most economically managed as National Forest lands. I shall now submit for your approval the proposition that the Department of Agriculture which is charged with the responsibility of protecting and administering the existing 156,000,000 acres of National Forest lands is best qualified to determine what lands are desirable for such purposes, and that the National Forest Reservation Commission is the one body best qualified to approve or disapprove their being designated for such use. In brief, no lands are to be reserved for National Forest purposes unless the Department charged with the responsibility of handling such reservations makes an affirmative finding as to their actual suitability for such use, and even then not unless the National Forest Reservation

Commission, considering all qualifying factors, believes such action will be in the public interest.

I shall not argue the proposition that, if it is decided that the lands should be reserved permanently for timber production and watershed protection, they should be administered by the Forest Service as a forestry problem. If such a conclusion does not appear to you as self-evident, then any arguments which I might make in its support would be subject to total discount as being special pleading. However, for purposes of this discussion I shall assume that Indian Reservation timber lands which are chiefly valuable for timber production and watershed protection and are contiguous to existing National Forests should be included in such Forests and administered by the Forest Service of the Department of Agriculture.

But, you ask, how about the Indians? Have they no rights in this matter, and are their rights and needs to be given no consideration whatever? Certainly, the rights and needs of the Indians must be given fullest consideration. And in this connection it is interesting to note that one of the more recent specific proposals for the inclusion of Indian timberlands in a National Forest originated in the Indian Service and was prompted by solicitude for the well being of the Government's wards. It appears in a special report submitted in response to a provision of law and prepared by a commission appointed by the Hon. Cato Sells, Commissioner of Indian Affairs, to investigate and report upon the present condition and future policy to be followed with reference to irrigation projects in the Flathead, Fort Peck, and Blackfeet Indian Reservations in Montana. Of these three Reservations the first named is the only one containing timberlands clearly suitable for National Forest purposes. Upon the subject of timberlands the Commission said:

"We find that there are 218,000 acres of timberland on the Flathead Reservation, 18,000 acres of which have been allotted to Indians and approximately 5,000 acres reserved for the use and benefit of the tribe. There should be further reserved for the benefit of the tribe 5,000 acres more, making a timber reserve on this reservation of 10,000 acres for the exclusive use of the Indians. This would leave 190,000 acres remaining of timberlands.

"The Act of 1912, which provides for the disposition of the surplus land on opened reservations, reads as follows:

"'That the Secretary of the Interior be, and he is hereby, authorized to cause to be classified or reclassified and appraised or reappraised, in such manner as he may deem advisable, the unallotted or otherwise

unreserved lands within any Indian reservation opened to settlement and entry, but not classified and appraised in the manner provided for in the act or acts opening such reservations to settlement and entry, or where the existing classification or appraisement is, in the opinion of the Secretary of the Interior, erroneous.'

"It is the opinion of this Commission that this act is an injustice and detrimental to the welfare of the tribe of Indians and is not conducive to good administration and should be repealed for the following reasons:

"Practically all the timber on this reservation is on the sides of the mountains which form watersheds and in which mountains are the sources of the streams from which water is secured for irrigation. If these timberlands are opened to entry whose watersheds would no doubt soon be divested of their timber, thus permitting the run-off from the various streams which furnish water for irrigation to occur earlier each year than it otherwise would, and making additional storage necessary at a great expense in order to supplement the flow during the latter part of the irrigation season, and in view of this fact we believe and recommend that the surplus timberlands together with the timber on said lands on the Flathead Reservation not otherwise reserved or allotted be purchased and acquired by the United States at the original appraised value of the timber, the same having been appraised, plus the value of the land to be appraised by a competent commission of three appraisers to be appointed by the President, and that said timberland be placed under the supervision of the National Forest Service and be made a part of the national forest reserve, thus preserving the water supply for irrigation.

"By the purchase of the timberlands on this reservation by the United States and causing it to become a part of the national forest the Indian property adjacent thereto will not be so greatly endangered, by reason of the fact that the Forest Service is equipped for the protection of the forests against fire.

"It might be well to say that we do not believe such a step would meet the approval of the unscrupulous speculators, and those who think the Indian should apologize for being here, and who spend their time trying to foil the plans of the superintendent in his efforts to better the condition of this tribe; therefore we believe it detrimental to good administration to add to the many duties of the superintendent that of acting in the capacity of appraiser of these lands to be sold.

"A further reason which this act should, in the opinion of this Commission, be repealed is because of the fact that it affords the homesteader, not only prior to filing but even after he has filed and proven up and paid for a tract of land, an opportunity to make application for reappraisement of the land, and in some cases they have availed themselves of said opportunity to the detriment of the best interests of the tribe, and in an effort to protect the Indians' interests in the field

officials incur the enmity of the so-called 'wolves' who live by preying upon the Indians."

The Commission followed this up by a special recommendation as follows:

"We recommend that the act of 1912 which relates to the classification and reclassification and appraisement and reappraisement of the timberlands on the Flathead Reservation be repealed as this act, in our opinion, encourages entrymen to make application for the reappraisement of lands even after filing and making final proof, and in addition to this it will eventually mean the destruction of the timber which makes the mountains so valuable as watersheds and eliminates the necessity for additional storage of water for irrigation.

"We do not believe the proposed amendment to Section 11 of the act of March 3, 1909, which provides for the opening to entry the timberlands on the Flathead Reservation, should be enacted into law. Such a law would mean that the homesteader could divest the land of its valuable timber after filing and making his second payment with the results as stated above.

"We earnestly recommend as being for the best interest of the Indians and in the interest of good administration that the United States purchase the timberlands on the Flathead Reservation not otherwise allotted or reserved and that the same be made a part of the national forest under the supervision of the National Forest Service. By so doing the timber will be cut under proper supervision and the watersheds will be preserved, and the run-off of the streams having their sources in the mountains will not occur so early each year as to make necessary the providing for additional storage for irrigation and the Indian property adjacent to the forests will be more amply protected from destruction by fire, because of the fact that the Forest Service is better equipped for this purpose."

This report was signed by the Superintendent of each of the three reservations and by the Superintendents of Irrigation. It is evident, therefore, that the inclusion of such lands within Forest Reservations is not a chimera originating in the minds of the Forest Service officers, but has strong support among other officials who have sincerely at heart the best permanent good of the Indians themselves.

The last three sections of the Snell bill do not adequately meet the Indian Reservation timberland problem, for the reason that legislation proposed fails to make specific provision for the liquidation of the equity of the Indians. They merely provide that the National Forest Reservation Commission shall "make recommendations to Congress for the purchase of such lands or otherwise for the liquidation of the

equities of such Indian tribes therein." This, I feel, is not sufficient. It leaves tthe Indians holding an empty sack, depending upon future action by Congress. I feel that the various steps should be as follows:

(1) A definite classification by the Secretary of Agriculture based upon dependable data; (2) Approval of that classification by the National Forest Reservation Commission; (3) Inclusion of the land within a National Forest by Presidential proclamation; (4) Appraisement by the Commission and determination of the proper price to be paid the Indians for the property taken over by the Federal Government, together with terms and manner of payment.

I do not feel that it is either necessary or desirable that the full purchase price be paid to the Indians before the land is added to the National Forest, but I do feel that before the lands are added there should be adequate machinery provided for determining the values, fixing the purchase price, and the terms of payment, making proper provision for the addition of interest earnings upon all deferred payments, and, finally, actually providing for payment within a reasonable time. Certainly it is not to the interests of the Indians for the Government to pay the entire amount in one lump sum and distribute that lump sum among them to be immediately dissipated by reckless improvidence. Neither is it to their interest to have the entire purchase price paid into the United States Treasury and held to their credit for future distribution without interest earnings. It would seem that the broad interests of the Indians would be better served by a plan which would secure to them the full value of the Indian lands as of their date of addition to the National Forests, plus a proper interest allowance upon all deferred payments, provided this is accompanied by the certainty of the receipt of not less than a definite fixed amount each year.

The form of legislation proposed by the Secretary's letter of January 23 so provided by making the Treasury share of the receipts from the National Forests within each State a fund available for the National Forest Reservation Commission to draw upon each year in the liquidation of such obligations to the amount of not to exceed $100,000 in any one State in any one year, plus the gross receipts obtained from the Indian Reservation lands added to the National Forests under the proposed plan. A careful canvas of the situation indicates that by this method the Indians' equity would be completely liquidated on each reservation area thus added to the National Forests within a maximum period of 15 years.

It may be urged that these lands should be retained by the tribe for future allotment purposes. Such a proposition is untenable, for the reason that lands chiefly valuable for timber production and watershed protection are not suitable for the purposes of individual allotment. It must be kept in mind that the idea of allotment contemplates that the allottee shall within a reasonable period become competent to handle his own affairs, and upon acquiring such competency shall be permitted to do so. The determination of competency will naturally be governed by the allottee reaching standards of living approaching the essential requirements of civilization. He will reach a stage of habits demanding food, shelter, and raiment substantially the same as his white neighbors, and he will also reach a stage of physical and mental training enabling him to meet those needs from the fruits of his labor and industry. It must also be remembered that when he achieves competency he will be subjected to the same taxation laws as other citizens. The most industrious and frugal type of Anglo Saxon cannot thrive upon non-agricultural land. It is therefore futile to expect it of the red man. Instead of alloting him a larger area of scanty agricultural possibilities, good economics and wise sociology suggest allotting to him an equal value of the best and most productive land obtainable. Instead of putting him upon a little cove of possible agricultural soil far back in the hills, remote from schools and settlements and civilizing influences, better give him an equivalent value of agricultural land so located that his papooses will play with the children of the whites and learn their language, habits, and customs from infancy.

Not only will the best interests of the Indians themselves be furthered by the Federal Government acquiring from them the remaining large tracts of land chiefly valuable for timber production and watershed protection, but the broad interests of the nation in which both whites and Indians are concerned demand that these areas be kept in their highest state of production. Unless this general principle is followed the result is certain to be a tremendous economic loss which will fall alike upon both guardian and ward.

DAMAGE TO FORESTS AND OTHER VEGETATION BY SMOKE, ASH AND FUMES FROM MANUFACTURING PLANTS IN NAUGATUCK VALLEY, CONNECTICUT

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The smoke problem as affecting vegetation is an old one. It has been critically studied abroad, notably by Wislicenus at the Forest Academy at Tharandt. It has also been studied by many investigators in this country. The problem has received more or less attention wherever large quantities of coal are burned and where ash and fumes from smelters, brass works, chemical factories, and other industrial plants emit large quantities of harmful substances into the surrounding air which later comes in contact with vegetation. Conspicuous among American investigations are those made in the vicinity of Pittsburgh, Pa., Des Moines, Ia., Ducktown, Tenn., and Butte, Mont. There is a voluminous literature on the subject and it has come to be generally appreciated that the smoke, ash, and other materials emitted into the air by agencies that use large quantities of coal, minerals, and chemicals may seriously injure or destroy vegetation completely. The amount of damage is directly proportional to the character and load of deleterious materials emitted into the air and which later reach the vegetation. Even the chimneys of residences and other buildings add to the contamination of the air. The damage, however, is not apparent unless the emissions escape in considerable quantities and over considerable periods of time as their effect on vegetation is cumulative.

Naugatuck Valley throughout its entire length in Connecticut is a great manufacturing center. The valley is narrow and for the most part with wooded slopes at either side. Large manufacturing plants that burn great quantities of coal and use vast quantities of zinc, copper, and other metals are located at frequent intervals throughout the valley. Furthermore a railroad threads the valley and adds materially to the atmospheric impurities.

The consumption of coal and metals began to increase rapidly soon after the outbreak of the European war and probably doubled before

the armistice was signed. What effect this rapid increase in manufacture and the resulting increase in atmospheric contamination has had on a vegetation already suffering from impurities in the air has not been adequately studied to permit of definite conclusions. The writer has spent some time studying the situation and has completed a series of investigations which throws some light on the amount and cause of the damage in specific localities.

From a general study of the woody vegetation of the valley it is apparent that the coniferous species are gradually disappearing and their places taken by more resistant broadleaved species. Although the general aspect of the forests on the slopes at either side and the isolated trees on the floor of the valley on the whole exhibit but little change to the casual observer aside from the gradual disappearance of the conifers, the experienced observer is impressed by the thinness of the foliage as compared with forests on similar sites out of reach of atmospheric impurities. The growth of all species throughout the valley is slow and increment borings made in a number of localities *indicate a marked falling off in growth since 1914 or since the great increase in atmospheric impurities.* Although studies are far too fragmentary for specific proof, the writer believes from those already made that the annual increment throughout the Naugatuck Valley is reduced somewhere between 25 and 50 per cent from the effect of atmospheric impurities.

Damage is by no means confined to the trees. Lesser vegetation of all kinds has also been injured and in certain localities near the stacks of large manufacturing plants grass has disappeared from the lawns and vegetable gardens have been ruined.

The damage throughout the valley has been chiefly due (*a*) to the large quantities of sulphur dioxide (SO_2) emitted with the smoke from all establishments that burn coal; (*b*) to the large quantities of zinc sulphate ($ZnSo_4$) derived from the flue dust (zinc ash) emitted with the smoke from brass works. In addition to these most important causes of injury other materials emitted with the smoke may cause minor injury but certainly not sufficient to be detected in the general appearance of the vegetation. For practical purposes, therefore, the damage to vegetation in the Naugatuck Valley can be assigned to the two materials mentioned above.

It is well known that when sulphur dioxide enters the air and comes in contact with the foliage of plants it is absorbed and oxidized into

sulphuric acid. Chemical analysis shows the presence of this acid in the tissue. When the acid becomes sufficiently concentrated within the tissues it is very toxic. Throughout the valley and particularly near the larger manufacturing plants coniferous leaves die at the ends and become reddish brown. Many are prematurely shed and the foliage is thin and open, as shown in figure 1. The leaves of many broadleaved species curl at the margins. Some show bright brown spots which gradually increase in size and run together, giving a characteristic mosaic appearance, as shown in figure 1.

The characteristic appearance of the foliage of both conifers and broadleaved species due to sulphur dioxide poisoning is in evidence in many places throughout the valley. The slow growth and thinness of foliage of pines, spruces, firs, and hemlock, together with the browning and casting of the leaves, makes their planting even for decorative purposes unwise near the centers of greatest atmospheric contamination. Red cedar and larch appear to be much more resistant than other conifers in the valley. The lesions or spots which often appear on the foliage of broadleaved species due to the destruction of the chlorophyll, although usually small at first, often in time embrace the entire leaf and all the chlorophyll disappears. When this occurs the leaf ceases to function and soon falls from the tree. With some species, notably elm and ash, every leaf on the tree may be affected. Birches, elms, cherries, thorns, locusts, ash, and lindens appear to be more sensitive to injury than willow, cottonwood, maple, and beech.

Although the direct damage to the vegetation from the presence of sulphur dioxide in the air is on the whole large, it is seldom that even conifers quickly succumb.

Wislicenus states that the injury noted above may begin when the atmospheric contamination reaches one part of sulphur dioxide in one million parts of air.

It is already evident in Naugatuck Valley that the closer the vegetation is to the source of air contamination with sulphur dioxide the greater the damage, though much depends upon the direction of the prevailing winds. It is possible to classify the degree of injury by mapping the vegetation in zones or belts of varying widths around each important source of air contamination. As the different species show considerable variation in the degree of sensitiveness to this poison they serve in each of these belts as indicators of the amount of damage.

It is well known from researches elsewhere that damage may extend for a distance of 10 or even 20 miles from the source of impurities. It is reasonably certain, therefore, that the large amounts of coal consumed at many points in Naugatuck Valley permit adequate sulphur dioxide to escape into the air to cause more or less damage to all vegetation. *This damage, however, is chiefly in reducing the foliage and as a consequence the rate of growth.*

Near the more important centers of coal consumption damage is more or less apparent to the casual observer. It should be emphasized, however, that a vast amount of damage in reduced growth occurs before it is apparent to the average citizen. When the damage from sulphur dioxide poisoning becomes so great it is conspicuous in the vegetation the air has reached a degree of saturation far beyond that of the first degree of damage.

The injury to vegetation from sulphur poisoning is not only direct through the action of sulphur dioxide on the foliage but is also indirect as appears later in this paper. The indirect damage is due to the action of the sulphur compounds in converting the insoluble gray oxide of zinc which forms the bulk of the ash into the soluble zinc sulphate which when in solution in the soil water is very harmful to surface-rooted plants. Pierce says that "the soluble compounds of zinc are highly poisonous to all plants though some species are better able to withstand them than others." Pfeffer says that "zinc sulphate is a very strong poison for all seed plants and when in solution in the soil water it is readily absorbed through the roots." Baumann says that "zinc salts can be presented to the living plant only in extreme dilution. A watery solution containing more than five milligrams of zinc sulphate to one liter of water (one part of zinc sulphate to two hundred thousand parts of water) acts injuriously upon seed plants."

Recent researches in Europe show that a large part of the damage from fumes and dusts from manufacturing plants is done indirectly through the effect of the chemicals contained therein on the soil and humus. The damage to surface-rooted vegetation like grass and garden truck in the Naugatuck Valley, particularly in the vicinity of brass works *appears to be chiefly due to this indirect effect rather than to the direct effect of sulphur dioxide on the foliage.*

The dust which escapes from the stacks is identical with that which remains behind as flue dust only it is more finely divided. It comes to rest at a greater or less distance from the plant on the soil and on

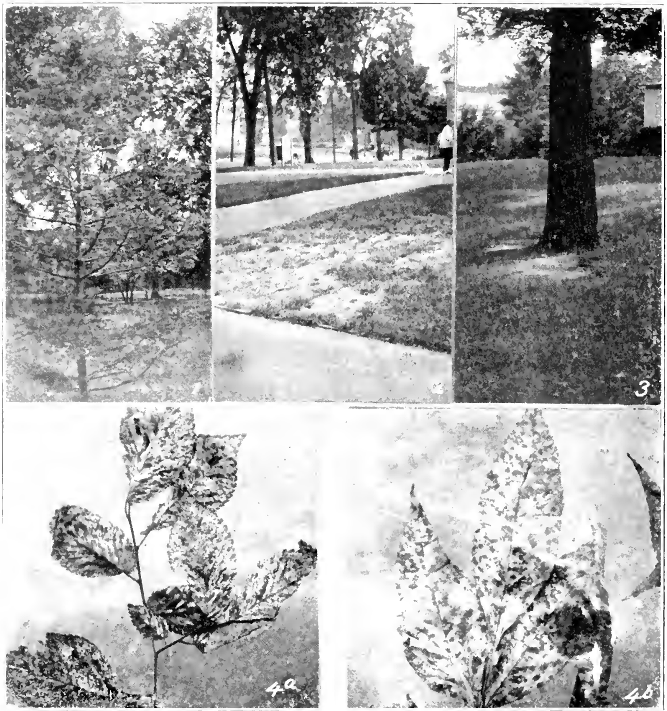


Fig. 1. Thinning out of the foliage of a fir (Abies) growing near a manufacturing center due to an excess of sulphur dioxide in the air.

Fig. 2. Destruction of the grass at the corner of a building due to dust emitted with the smoke from a brass mill. In this case the dust accumulated on the roof was washed by rains over this part of the lawn.

Fig. 3. Destruction of the grass at the base of a tree in Naugatuck Valley due to dust emitted with the smoke from a brass mill. In this case the dust which accumulated on the tree crown was washed by rains down the trunk.

Fig. 4. Characteristic mosaic appearance of the foliage of broad-leaved species due to an excess of sulphur dioxide in the air. Photograph taken near a manufacturing center. (a) Elm, (b) Ash.

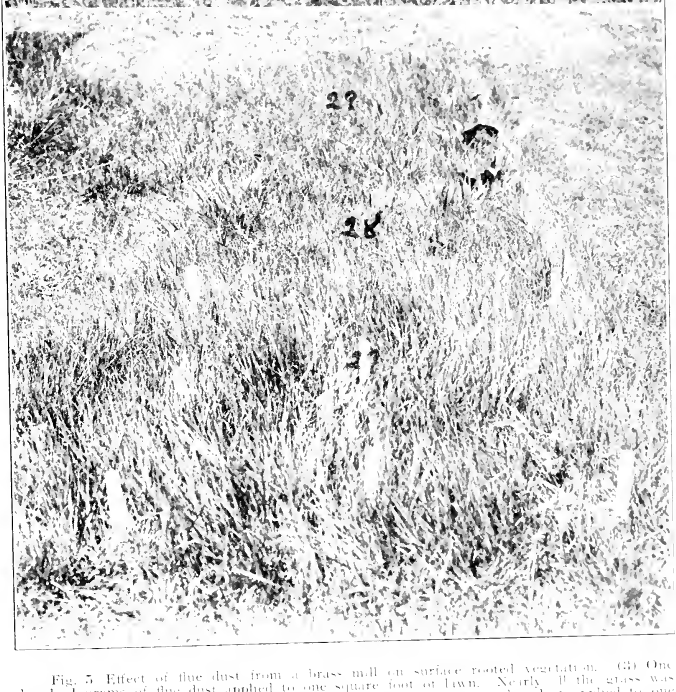


Fig. 5 Effect of flue dust from a brass mill on surface rooted vegetation. (3) One hundred grams of flue dust applied to one square foot of lawn. Nearly all the grass was killed within a period of two weeks. (4) Two hundred grams of the dust applied to one square foot of lawn. All vegetation was killed within a period of two weeks. No later growth started on the plot during the entire season

Fig. 6. Effect of the flue dust combined with an equal amount of air-slaked lime. (27) Two hundred grams of flue dust combined with an equal amount of lime. (28) One hundred grams of the dust combined with an equal amount of lime. (29) Fifty grams of flue dust combined with an equal amount of lime

all sorts of objects growing in the soil or resting thereon. The flue dust, taken from brass mills shows on analysis a large percentage of the insoluble zinc oxide. It also shows a high percentage of the radical SO_3 as illustrated in the following representative analysis: Copper oxide, 4.26 per cent; zinc oxide, 26.13 per cent; lead, .018 per cent; total SO_3, 8.98 per cent.

The relatively high percentage of zinc oxide and SO_3 clearly indicate that the two substances are the chief sources of injury to the vegetation in that the sulphur compound acting on the insoluble zinc oxide makes it soluble in the form of zinc sulphate.

Analyses of the surface soil taken from representative areas where marked damage to surface-rooted vegetation had occurred showed the presence of zinc in soluble form. It is evident that the conversion of the zinc ash into the soluble zinc sulphate is constantly going on after the ash comes to rest on the soil so long as the radical SO_3 is present and is as constantly being absorbed by the vegetation.

Vast quantities of ash escape from the brass mills into the valley and come to rest not only on the soil but on trees, the roofs of houses, and other objects. The finer particles are carried a mile or more before coming to rest. Other things being equal, however, the amount of ash which reaches the soil is directly proportional to the distance from its source and the direction of the prevailing wind.

When the ash with its contained radical SO_3 comes to rest on the foliage of trees and other vegetation, if moisture is present part is converted into zinc sulphate. Some of this may be directly absorbed by the foliage but as little moisture passes directly from the surface of leaves to their interior the amount of zinc sulphate which enters the leaves by absorption is practically negligible. On the other hand, when the ash which falls directly on the soil or is washed from trees and other vegetation and from the roofs of buildings into the soil *the soluble zinc is absorbed through the roots.*

Its presence in the soil is quickly detected by its effect on the vegetation. Deep-rooted plants like trees suffer little damage because the roots are out of reach of the greatest concentration of zinc sulphate but surface-rooted plants suffer great injury and are frequently killed because the roots are in the top layers of the soil where the greatest concentration of the soluble zinc occurs.

Visible damage to grass and other surface-rooted plants takes place when the accumulation of flue dust (zinc ash) on the surface soil

reaches 25 grams per square foot of surface and all vegetation is quickly killed when it reaches 200 grams per square foot of surface.

The damage to lawns and gardens due to the absorption of zinc sulphate through the roots is conspicuous in many parts of the valley. In some places even in midsummer the sod has been destroyed and the soil covered with dead grass. Even with the best of attention the grass becomes very thin and dies out in large patches giving the lawn a sun-scorched appearance. The total destruction of all surface vegetation is particularly noticeable in depressions, at the base of trees and where the ash collects in more than average amount. Thus large amounts of ash reach the areas immediately around the base of the tree trunks due to its accumulation on the crowns and later being washed by the rains down the trunks. This accumulation causes the death of the grass, as shown in figure 3. It is also noticeable that there is no grass at the corners, as shown in figure 2, and under the eaves of buildings where washings from the roofs flow over the surface, due to the accumulation of ash on the roofs being washed at times of rain onto a limited area of surface. In general the grass is likely to disappear in all low places or depressions in lawns and on terraces facing the source of air contamination due to these areas receiving an excessive amount of ash.

In order to determine the amounts of ash (flue dust from zinc mills) that cause different degrees of injury to grass and other surface-rooted vegetation and in order to ascertain a practical method for overcoming the injury seven series of experiments consisting of twenty-nine separate numbers were planned and executed by the writer in the summer of 1920.

Ash was collected from the stack of a large brass mill in Naugatuck Valley. In one series of experiments the ash in varying amounts was applied to definite areas of a thrifty grass plot. In another series the ash was mixed with air-slaked lime before being applied. In looking about for a practical method of neutralizing the toxic effect of the zinc, lime suggested itself as a possible remedy. European investigations have shown that lime is especially necessary in soils exposed to acid fumes. In the second series of experiments varying amounts of air-slaked lime were mixed with the ash and applied in different quantities to equal areas of a thrifty grass plot.

The results obtained from two series of experiments permit the following conclusions:

(1) The ash from brass mills causes more or less damage to surface-rooted vegetation when uniformly applied in summer over the surface in amounts of 25 grams or more per square foot of surface, as shown in figure 5.

(2) When less than 25 grams are applied per square foot of surface no apparent injury takes place.

(3) In amounts in excess of 25 grams per square foot of surface the damage appears to be proportional to the amount of ash applied up to 200 grams which completely kills all surface-rooted vegetation within two weeks after its application.

(4) The application of air-slaked lime in mixture with an equal amount of ash completely prevents all injury even in cases where as much as 200 grams of the ash is applied to one square foot of surface, as shown in figure 6.

(5) The application of air-slaked lime in mixture with an equal amount of ash up to 200 grams of each per square foot of surface appears to greatly stimulate growth, much more than the application of the lime alone.

From these experiments it appears that serious damage to surface-rooted vegetation due to the ash (flue dust from zinc mills) can be entirely overcome by keeping the soil well limed, thus preventing the formation of zinc sulphate and its solution in the soil water. An interesting outcome of the investigation is the apparent stimulating effect on growth due to the application of the flue dust and lime in combination.

CLASSIFYING FOREST SITES BY HEIGHT GROWTH

By E. H. Frothingham

U. S. Forest Service.

THE NEED FOR SITE CLASSIFICATION

A forest site, according to the Society's "Forest Terminology" of 1916,[1] is "an area considered as to its physical factors with reference to forest producing power; the combination of climatic and soil conditions of an area." The prime reason for differentiating sites being, however, the difference in their capacity to produce wood, this fills the stage in practical work and forces the causative factors into a somewhat nebulous background.

An inventory of lands considered as to wood-growing capacity has initial importance in forestry. It is necessary at the outset in forest management, in which *land quality* and *market* affect every phase of the business. It is one of the essentials for intelligent yield forecasts and for the estimates of future income upon which present and future expenses may be justified. In America the management of large areas of forest land is waiting upon such inventories.

There is, therefore, an urgent need for a simple method by which sites may be quickly and easily classified. In order to classify sites there must be some standard to measure by. The height growth of dominant trees is an easily and widely applicable standard of measurement. This paper will discuss Professor Roth's plan for site classification by the height at a stated age, the rôle of height growth in general as an indicator of site, and, finally, some of the features and possible developments of the Roth plan.

OUTLINE OF PROFESSOR ROTH'S PLAN

In his paper, "Concerning Site,"[2] Professor Roth has outlined a plan for site classification on a large scale. This plan would provide a simple arrangement of site classes good for the whole country, or any

[1] Compiled by a committee of the Society of American Foresters and published in the JOURNAL OF FORESTRY for January, 1917, Vol. 15, No. 1.

[2] *Forestry Quarterly*, March, 1916, Vol. 14, No. 1, pp. 3-12.

part of it, and for any tree species for which certain elementary data are available. On the principle that the rate of height growth of dominant trees is a practical index of the site quality (when used with trees which have passed the juvenile stage), Roth suggests choosing a single uniform age (100 years) as a reference point and classifying the sites in terms of the height attained at that age by dominant trees. He would distinguish between tall, medium, and short species, and for each of these groups would supply a set ("standard") of site classes. The table used for illustration in his paper is as follows:

Standards of Site Classification Based on the Height of Tree at 100 Years

Site	Standard a *Feet*	Standard b *Feet*	Standard c *Feet*
I	110	90	70
II	90	75	60
III	70	60	50
IV	50	45	40

These standards and sites within standards would, of course, be based upon the performance of representative species. The table cited is merely illustrative. Thus the maximum height given (110 feet) may prove to be too small, or the three standards may be too few to provide for all our important species (although a consideration of the growth habits of these species will bring out many resemblances, making it appear probable that all could be provided for by a very small number of standards).[8] It is not essential that every one of the species composing a "standard" (i.e., reaching approximately the same maximum height on the best site) should be represented in every one of the sites within that standard. If, for example, yellow poplar and chestnut belong to the same standard (being rather similar in growth rate on soils occupied by both), the chestnut would be found on all the sites, from site 1 (cove) to site 4 (ridge), while the poplar would be limited to the sites representing cove and lower slope conditions. Great importance is placed by Roth upon the need for simplicity in any comprehensive plan of classification. This plan is, therefore, pretty well stripped to its bare essentials.

THE DOMINANT HEIGHT AS A SITE INDEX

From a theoretical standpoint the true index of site is doubtless the volume per acre. The possible yield per acre in cordwood or lum-

[8] In the writer's opinion, however, each forest region might have its own site *system*, related to those of other regions by the common *method* employed.

ber—which is the center of interest in forestry, as bushels of potatoes or barrels of corn are in agriculture—is the direct and reasonable measure of the site *when it is available.* The truth is that it is rarely available. We have yield tables for a number of species, which are in all or nearly all cases based upon and only intended to be applied to even-aged, well-stocked stands. Thus our yield tables, which are themselves site class tables, cannot be used directly in the identification of sites except when the stand is even-aged and well-stocked. In these tables, however, a relation between yield per acre of regular stands and height growth of dominant trees is shown to exist, permitting the use of the latter as a guide to the former. This relation is true of board foot as well as cubic foot yields. There are other factors—total basal area, number of trees per acre, and average diameter—which vary with the yield, but none of these compares with height growth in degree of freedom from the effect of influences which are not inherent in the site. Of all the factors of yield, height growth is the best expression of the physical components of the site. It is the most convenient since it makes possible the identification of sites by the simple determination of the age and height of dominant trees. In the case of forest lands not well stocked it is *the only possible factor* which *could* be employed without laborious and as yet doubtfully practical studies of the physical factors themselves.

The American yield tables have been criticized for their failure to describe sufficiently, if at all, the physical factors of the sites. This failure to tie up the causes with the effects produced was unfortunate but apparently unavoidable, since we yet have no simple way of measuring and expressing the significant physical factors, suitable for use in every day field work. Meanwhile there is much work to do. Large areas, often of complex topographic and soil character, must be classified in some way reflecting the growth potentialities. With some easily observed precautions, the rate of height growth (summed up by Roth, for classification purposes, as the height at a commonly agreed upon age), furnishes a means of accomplishing this.

There is nothing new in the use of height as an indicator of site quality: witness the yield tables above referred to. The novelty consists in the proposal to *standardize* its use and extend it beyond the yield tables to which it has hitherto been restricted.

SOME FEATURES AND POSSIBLE DEVELOPMENTS OF THE PLAN

There are some difficulties which must be settled if the case for height-growth is to receive serious consideration. What, for instance, is the justification for selecting one particular age as a reference point? How can the quality of site be judged on the basis of height except by the use of the entire growth curve? How can the site requirements of trees with different height-growth curves be compared on the basis of the height at any given age? And if they can be so compared, of what use is the comparison if trees of this particular age are not available for measurement? These questions strike to the heart of the plan; answers to them should go a long way toward explaining its purpose and its limitations and advantages for practical use.

Growth curves versus the height at a uniform age.

The reason for selecting a single common age is simplicity—an essential attribute considering the diversity of the material to be classified. By way of analogy, if volume per acre were a practicable site index the same consideration would have to be regarded; instead of whole yield tables or yield curves we might use, for the *classification* of sites, the yield at a stated age. For the *field identification* of sites, however, the entire curve or table would be essential, for if only the yield at a single age were provided the site could not be determined when occupied by a stand of any other age. Similarly, in the height classification plan, a considerable part of the height curve or table is necessary for the *identification* of sites. If it were possible to arrange a classification of height-growth curves or tables for all the important species on their different sites which would be simple enough for use in ordinary field work, such a classification might be superior to the single age-height reference point. As it is, the height growth curves are a necessary adjunct to the height-age reference point, which is used simply because curves or tables do not lend themselves to practical classification.

The single age-height figure may then be regarded as simply an index designating the intersection point of the curve which it represents with the ordinate at 100 years. In other words, while the site is *catalogued* in terms of height of a species at one stated age, it is *fully expressed* only by the entire curve; and it is only by reference to the entire curve that it can be determined for trees of any other age. The points of intersection of the growth curves with the ordinate repre-

senting the selected age thus become, in effect, a key to the curves themselves. The height growth index must therefore be considered simply as a ready means of correlating height growth data previously secured. Its function is to identify and give a name to the site.

The site interval of 10, 15, or 20 feet (see Roth's table on a preceding page) provides for a considerable range in height at 100 years. In many cases the height growth curves of a number of different species will undoubtedly fall within a possible set of limiting curves which may be drawn through the site interval points set up at 100 years. An illustration is the set of curves for southern upland hardwoods illustrated in the January issue of the JOURNAL.[4] The similarities in the rate of growth were such as to appear to warrant a single set of site curves for a number of Southern Appalachian hardwoods, based at the outset on chestnut. Each species has, of course, its own characteristic growth habit; but the differences are insignificant, usually well within the limits of consistent accuracy imposed by other factors. The height growth of these intolerant hardwoods is similar enough to be regarded as identical for many practical purposes.

It should be emphasized, however, that in the proposed plan sites are classified for one species only. If other species fall in closely enough to be grouped, well and good. Generally this is very secondary, but natural groupings of species of similar height growth on the same sites, and therefore belonging to the same "standard," will be of manifest value. At 100 years the height growth of most of our important species on most of their sites closely reflects the site conditions.[5] For these species the height at 100 years may be (somewhat figuratively) said to epitomize the height-growth capacity of the site. The century is a rather appropriate time unit in forestry, corresponding with a frequently expressed rotation period and also, roughly, with the stage in the life of a majority of our species at which they are "flattening off" in height growth.

Before a species can be assigned to its proper "standard" in the height classification scheme its height at 100 (or 50) years *on its best*

[4] "Site Determination and Yield Forecasts in the Southern Appalachians," by E. H. Frothingham, JOURNAL OF FORESTRY, 19:1-14. 1921.

[5] At this age the differences in growth, as a result of differences in site, are well marked. For short-lived species and those which (like poplars, loblolly pine, etc.) flatten their growth curves at an early age, 50 years is better, as suggested by Watson (JOURNAL OF FORESTRY, 15:552-63, 1917). There are few, if any, species of such sustained growth as to require the placing of the reference point at greater than 100 years.

site must be known. The limits of all its sites then correspond to all or a part of those of the standard to which it belongs.

Why not a single standard?

It will be noticed that in Roth's table of "standards of site classification" the site intervals under a given standard are of equal width, but that the standards differ in this respect, standard "a" having 20-foot site intervals, "b" 15, and "c" 10. Each is a multiple of 5. The question arises why a single standard could not be used for all species, all sites having equal amplitude of, say, 10 feet. With a range of from 110 to 40 feet there would thus be eight sites in the single standard. A dominant tree of any species which is 70 feet high in 100 years would belong to "site 5" and no question about it—whether or not it were on its best site. The best site for the species included in Roth's standard "c" would become "site 5" and the poorest "site 8." This would certainly greatly simplify matters. Roth's objection to it is that site is always a matter of species and must bear the species mark, as "jack pine, site 1" ("standard c, site 1," being only another way of saying "jack pine, site 1," or "tamarack, site 1," or "white oak, site 1," as the case may be). To say that the best height growth of jack pine indicates only site 5 is not only an offense to the species but is in opposition to our generally accepted way of looking at things: "1" means best for whatever particular commodity—wheat, mortgages, or trees—we are talking about. Roth would sacrifice the simplicity of a single standard to what he considers the demands of our psychology. The single standard would be too great an innovation and might cause much confusion.

THE HEIGHT-GROWTH BASIS IN USE

Watson (*op. cit.*) has told how the identification of sites by the height-growth method may be applied in timber reconnaissance. It is simply a matter of recording the height, age, and species of dominant trees measured in the areas traversed, and their comparison with standard height growth curves indicating site limits for the various species concerned. Each of the areas may then be assigned to the site (or sites) designated in the standard classification for any of the species which may have been measured.

The choice of trees for measurement is an important matter. The trees selected must be normal, dominant, and (unless certain conditions can be shown under which this is unnecessary) there must be sufficient

evidence that they have been in the upper crown cover from the start. This is likely to be easy for intolerant species, and intolerants will therefore be the best indicators. Even tolerant trees, however, can probably be safely used if carefully chosen, and facility will undoubtedly come with practice. Beyond the century mark, and considerably in advance of it for many species, especially on the poorer sites, height growth is so slow that it may be regarded as practically at a standstill. The average height of the dominant crown cover of old stands, even when of tolerant species, will therefore probably constitute a good index of the site—the site, of course, being determined by reading back between the site limiting curves to the 100-year point.

Site determinations may frequently be checked by measurements of dominants of the same species but of different age classes, when such occur on the area. Whenever possible, determinations should be based on several measurements for the same species. For many species it will be unsafe to rely upon determinations based upon young trees, of less than 30 or 40 years. "Giant," "dwarf," and "wolf" trees should, of course, be avoided.

The trees selected as site criteria should be forest, not open-grown trees. It is possible that later studies will reveal relations between the rate of height growth of isolated and forest-grown trees of the same species on the same sites, by which isolated trees may be used as site indicators; but until this is done the choice should be limited to dominant trees which have participated in the crown cover. These may, of course, be trees which have been left isolated in cuttings, and when this is the case there can be little objection to their use, provided their former dominance is evident from crown shape and size, size of bole, intolerance of the species, etc. Even then, the determination should not depend upon a single individual, but upon an average, or the measurement of trees of other age classes as well.

It is thus apparent that the adoption of this general method of site classification would place a large premium upon growth data of all kinds. A tremendous incentive would be given for studies of height growth of all our species, with reference not only to site but also to the effects of differences in the density of stocking, etc. Compared with studies resulting in normal yield tables, height-growth data are extremely inexpensive. For many of our species *normal* yield tables simply cannot be had at present; even the preliminary attempts are costly and require much judgment and effort. In order to make the

forecasts which, as explained at the beginning of this paper, form the prime object of site classification, yield tables or some kind of forecast tables must, however, be provided. By conforming all yield tables which are made to the various standards and sites provided in a general height-growth classification system, it will quite likely be possible to reduce the number of yield tables otherwise necessary, since means of evaluation from one species in terms of another may be found practicable. This might, for example, be accomplished through comparisons of the total basal area per acre. Forecasts are always subject to the uncertainties of the future and so are none too reliable even when based upon yield tables definitely representing the type and site concerned. Such evaluations may therefore come well within a reasonable limit of error.

CONCLUSION

Height growth, like any other criterion of site value based on the actual crop, cannot be used for classifying bare lands. In young stands it must be used cautiously, although in these it may often be the only criterion of any use whatever. To balance these shortcomings is the undeniable advantage that it can be used in understocked as well as fully stocked forest, in wild woods as well as in plantations. Being thus widely applicable, it furnishes a medium by which the growth potentialities of large areas now covered with irregular forest may be estimated and classified.

Under the proposed plan, existing and future site classifications for individual species would be co-ordinated into one general scheme. Resemblances and contrasts would be given a practical bearing. A given forest soil would be judged in terms of the different species dominant: oak as compared with maple, spruce with larch, etc. White pine sites in New England would be placed on a common basis of comparison with white pine sites in Tennessee and Minnesota. Yield tables for different species, based upon the common age-height classification, could be much more readily compared than at present and the productive capacity of the site thus gauged in terms of each species. All this could be accomplished without an intensive study of the causative factors, although such studies would by no means be excluded and the site classification could later be enforced or verified by determinations of the physical factors.

A GENERALIZED YIELD TABLE FOR EVEN-AGED, WELL-STOCKED STANDS OF SOUTHERN UPLAND HARDWOODS

By W. D. Sterrett [1]

Forest Examiner, U. S. Forest Service

The importance and use of site classification work, based on age and height, the principles of which were carefully regarded in the preparation of the generalized yield table to be discussed will first be summarized. An outstanding feature in the future development of forest mensuration in the United States, it seems to me, will be to tie up to quality of site all growth and yield tables for a given species, both for single trees and stands, and, to a less extent, form and volume tables, using average height attained by dominant trees as an index for judging quality of site. Height has long been recognized and used in Europe as the most practicable index for judging differences in yield capacity of different land for a given species. Quality of site, as indicated by height, is much more definite and precise as a factor for indicating possible rate of growth and yield on different lands than the much abused term "forest type." The latter often includes several distinct qualities of site, and in other cases a given quality of site might embrace several *forest* types. *Physical* types, on the other hand, based chiefly on soil and physiography, which correspond to a given quality of site as determined by height for a given species, are also important for determination and description in site classification work for a species.

The first step in making growth tables for a given species should be the construction of a series of age-height site curves based on sufficient data to cover the range of sites on which it grows, the range in age classes from young to mature, and sufficient to establish the proper direction of the curves for each site class. Growth tables for single trees and stands should be made separately for the different age-height site classes thus determined. In making age-height site curves it has been found most convenient to make even intervals between the curves.

[1] The yield curves (see figure) were prepared by E. H. Frothingham.

This means that by plotting data for the best and poorest sites and drawing maximum and minimum curves, as many interior curves with even intervals can then be drawn as may be desired, although some interior data, showing height growth of individual trees, are highly desirable to establish and support the proper direction of all the curves.

A central point in future age-height site classification work, it seems to me, will be to compare and co-ordinate the age-height classes of different species. This can not conveniently be done on the basis of site class curves for the different species, as the direction of their height growth curves varies too much at different periods in their lives. It becomes necessary, therefore, to choose a single age at which to compare the height classes attained by different species—a point Professor Roth has been stressing for the last five years. Roth's recommendation of 100 years seems to me to be a suitable age to choose, as it would occur shortly after the culmination of the main height growth in all but a few rapid growing weed species. To make comparisons between species most readily, it would obviously seem best to adopt a standard series of 100-year height classes with sufficient range to cover all species in the country and with a sufficient number of intervals and classes so that age-height site curves for any given species can be made to coincide with these standard intervals at 100 years without serious distortion of supporting data. By drawing a set of curves for a given species through such a set of standard 100-year-height intervals, it should be possible to at once precisely co-ordinate its growth with that of other species. Standard 100-year-height classes would also facilitate correlation and comparison, in terms of different species, of the productive capacity of different physical types or complexes of physical factors. A piece of land constituting a physical type of a given description may often be in one standard height class in terms of one species and in another class in terms of another species.

The following is suggestive of some possible standard height classes [2] and methods of numbering them (from the ground up) which it would be useful to consider in connection with the subject of standard 100-year height classes, using 10-foot and 20-foot intervals and with a range in height from 0 to 210 feet:

[2] These classes are on the basis of a single standard for all species in contrast with the triple standard proposed by Roth; his standard "A" would be for species attaining 150 feet or more, "B" for those attaining 120, and "C" for those only reaching 90 feet; for each one of which standards the sites would be numbered independently.

Height classes (feet)	Numbers assigned to the classes
A.—CLASSES WITH 10-FOOT INTERVALS	
0 to 10; 10-20, etc., up to 190-200	1, 2, etc., up to 20
B.—CLASSES WITH 20-FOOT INTERVALS COMMENCING AT THE GROUND	
0 to 20; 20-40, etc., up to 180-200	I, II, etc., up to X
C.—CLASSES WITH 20-FOOT INTERVALS COMMENCING 10 FEET ABOVE THE GROUND	
10 to 30; 30-50, etc., up to 190-210	Ia, IIa, etc., up to Xa

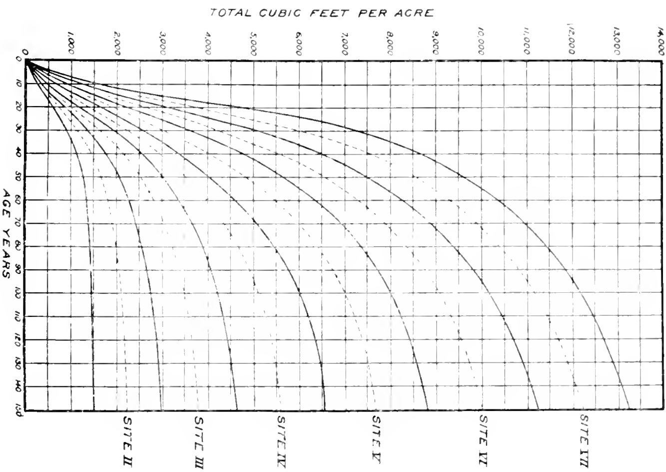
Although three sets of standard height classes are indicated, A, B, and C—the last two (B and C) are merely combinations of the first "A," on the basis of 20-foot instead of decade intervals, the "B" series being for classes separated at even decades, while the "C" series are separated at odd decades. Where 20-foot intervals are desired in some cases it would be more convenient to have curves for a given species coincide at 100 years with the "B" height classes and in others with the "C." A 20-foot height interval will be sufficiently close for many of our species at the present stage of forestry development in this country. When the standard "A" site classes are applied to a given species, the Arabic numerals at once indicate the heights attained, as, for example, if a species were classified as reaching class 9 as a maximum this would at once indicate that 90 feet was the best it could do, while one which reached site 10 would have a maximum of 100 feet, and so on. This is one of the advantages of numbering the sites from 1 up, instead of vice versa. In the standard "C" classes, the average height of a given class would be double that indicated by the height class numeral, and in "B" it would be double minus 10 feet.

The yield table to be discussed is largely the work of Mr. Frothingham, using as a basis plots I had under compilation for a bulletin on the eastern oaks. The computing was largely done by Miss Elsie B. Stabler of the Forest Service.

The yields in cubic feet for different ages are graphically shown by the curves (see figure). The curves are based on 370 plots, of which some 345 were taken in western Maryland in 1910, 1911, and 1912, by crews working under State Forester Besley, in co-operation with the U. S. Forest Service, and some 25 were taken in the Southern Appalachians, in 1915 and 1917, by Frothingham.

These curves indicate the growth and yields of well-stocked stands (density 0.8 or more) of southern upland hardwoods on the different

sites established by Frothingham [3] in his age-height site class curves for southern upland hardwoods, which in turn are tied up to the suggested standard 100-year height site classes, "C" series, given on page — of this article, commencing with site IIa for stands with dominant heights of 30 to 50 feet at 100 years, and ranging up to site VIIa for heights of 130 to 150 feet.



The table is a generalized yield table based on plots representing a wide variety of types and is a distinct departure from the ordinary conception of a normal yield table as one made for a single species or type.

The striking thing brought out by the study is that the total cubic yield of well-stocked stands varies fairly uniformly with the average height of dominant trees in the stand, regardless of differences in type and prevailing species. This is shown by a tabulation of the number of plots by types and the per cent of selected plots in each type, that is, plots which fell in the same site class in volume as in height—according to the age-height site class curves.

[3] For discussion and basis for these curves see article and diagram on "Site Determination . . . in the Southern Apalachians," JOURNAL OF FORESTRY, January, 1921.

[illegible] plots were divided into types and the types named on the basis of [illegible] prevailing in total cubic volume of the stand in each [illegible] chestnut plots were divided into two types, those which were [illegible] per cent or more chestnut" in volume and those which were "less [illegible] per cent chestnut" in volume. The following is a tabulation [illegible]

[illegible]

still fall in the same general site class in volume as in site based upon height. A yield table on this basis, however, would not be as representative of actual conditions.

After the generalized cubic volume curves had been drawn the selected plots, separately for each type, were plotted with reference to these curves. It was found that the plots for the "chestnut over 50 per cent" had the widest range in yields—from site III to VII. "Chestnut under 50 per cent" plots range from III up to V. The chestnut oak plots range from site II up to V, which is the lowest range of any of the oak or chestnut types. White oak ranges from III to V, red oak IV to V, black oak III to VI, and scarlet oak III to V. Yellow poplar, including plots by Ashe, range from IV to VII in volume. The one black cherry plot taken is in site VI, while one plot each of pitch pine and beech are in site II.

The board-foot volume curves indicate at 50 years a range in yield of 400 board feet per acre for site III, with none for site II, up to 21,000 feet for site VII, while at 100 years the range is from 1,250 board feet for site II up to 40,000 feet for site VII.

While there is no great difference due to type in total cubic yield for a given standard site, yet what is of more practical importance is how the different types vary from the generalized yield table in possible board foot yields. This was shown by plotting the selected plots, separately for each type with reference to generalized board foot volume curves, and labelling the site class of each point plotted according to its height and cubic volume. It was surprising to find how little the different types vary in their board foot volume, for plots of a given site according to height and cubic volume, from the generalized board foot volume site classes. The chestnut oak plots varied the most, a large number of which fell in a lower site class in board foot than in cubic volume. This was to be expected from its thicker bark. The "chestnut over 50 per cent" plots, on the other hand, tended to show greater yields in board feet, for plots of a given site according to height and cubic volume, than the generalized board foot volumes for that site would indicate; and the one pitch pine plot showed very much greater board foot volume, being in site IV instead of site VI as in height and cubic volume.

It is of practical importance to see how the generalized table fits conditions farther north and west. This was done for 233 plots taken by Frothingham, and 30 plots taken by Schwartz in Connecticut. These

were classified under five types: Chestnut 50 per cent and over, chestnut under 50 per cent, chestnut oak, white oak, and black oak. It was surprising to find 55 per cent of these plots agreeing with the yield table in volume for sites determined on the basis of height. One reason why more of the plots did not agree was because the average dominant height in the Frothingham Connecticut plots was primarily determined on the basis of chestnut, even for types in which this was not the prevailing tree. Sixty-seven per cent of the chestnut plots agreed in volume and height with the yield table.

The above comparison with Connecticut plots suggests the possible applicability of the table to even-aged, well-stocked, stands of southern upland hardwoods over a wide range of territory, possibly from northern Alabama to New England and westward to the Mississippi River. This, however, is a matter for determination and one which can be accomplished for each particular locality by taking a comparatively few plots representing the range of sites present.

The field of practical use for yield tables in the United States, in predicting the growth of particular stands, is customarily considered to be a very narrow one because of the difficulty of determining what site class to use in a particular case, and because such tables are usually only good for pure stands of a single species or type and which are even-aged and fully stocked, such as form but a small per cent of our forests. The question of site determination in application of the table is fully provided for, however, if the table is carefully tied up to age-height site class curves, such as established in the present case. The table given here also shows the possibilities of covering a wide range of types and species in a general yield table. The field of possible application of such tables in predicting yields of understocked and irregular stands is, the writer believes, susceptible to considerable development. This includes their use for even-aged, understocked stands following clear cutting, or for stands of mixed young and old growth where the latter is about to be removed so as to leave the stand even-aged within broad limits; also as a useful check on local yield tables made by the stand table method where the rate of growth of the stand is figured from the rate of growth of individual trees of different diameters. In applying the yield table to understocked stands, it would be necessary to determine the present per cent of stocking (compared to well-stocked stands of the yield table), to estimate what this percentage of stocking will be at different periods in the future, and to

make allowances accordingly in predicting yields. The per cent of full stocking increases with age, so that stands which are understocked in youth, in number of trees per acre, often close together later on in life, and have equal final yields with stands which were well stocked from the beginning, as has been shown by Carter to be the case with white pine. The possible application of the table to uneven-aged stands would involve the determination of its average economic age, or general age-class, and the density of stocking, present and future, of the main crown cover trees.

It is believed that the making of complete yield tables, such as include a large number of factors (number of trees, average diameter breast-high, average crown width, separate for dominant and subordinate parts of the stand, etc.) and a thorough analysis of these factors, should open up new possibilities of application. In predicting the yield of an understocked stand it would be useful to see to what age in the yield table the number of main-stand trees it has per acre would correspond. By subtracting from this age the present average economic age of the stand a useful figure could be secured by which to gauge the time necessary to elapse before the stand would reach the yields and stocking given in the table. This should, if possible, be checked by consideration of the present average diameter and crown area of the stand, and the average diameter and crown area given in the yield table for different numbers of main stand trees per acre when well stocked.

In conclusion it seems to the writer that the importance of yield tables for well-stocked regular stands has been greatly underestimated, and that the subject has not been given the position of relative importance it should have had in comparison with other forest investigations. Yield tables are, in the writer's opinion, a matter of such importance that they could well be given first consideration in forest research for an extended period; for is it not obviously important to forestry development to secure land to be set aside for growing of timber? And how can classification of lands for timber growing be fully justified if it is not known what it is possible to produce on all different classes of land under forest management and on any particular parcel of it that comes up for consideration?

NATIONAL NEEDS AND SUSTAINED ANNUAL YIELD OF THE NATION

By Russell Watson

Assistant Professor of Forestry, University of Michigan

The following approximations of possible timber growth in the United States may be of interest.

The assumption is generally held that the country is using timber some three or four times as fast as it is growing. It is interesting now, to see what the total national possibilities are of timber production.[1] Is it possible, on the available forest land of the country, to produce as much timber as is needed by the nation, or will the 463.5 millions of acres of such timber land grow each year much more timber than we will ever use annually? In short, if we use no more wood in the future than we do now, can we be self-supporting under good forest management, or must we expect to be importers?

Consider the loss of growth as a result of insects, fire, etc., as a minimum, and consider the forest well stocked with trees—not the theoretical normal stocking, but rather just nicely stocked—that is, about 70 per cent normal stocking. Also consider that the forests are well stocked with the more desirable species of trees, not scrub stuff, culls or weed trees. The growth resulting from this, then, may be said to be as good a growth as may reasonably be expected. But note that it is promised that the forest protection is good. As good as is given in the better European forests.

It is believed the figures of growth in Table 1 will be found to be about true.

These figures are interesting in comparison with the better European results in forestry. On the Wurttemburg State Forests of Germany (about 500,000 acres), the average actual production for the period 1900 to 1908 was 77 cubic feet per acre per annum.

The English are figuring about 45 cubic feet per acre per annum as their possible production in Great Britain.[2]

[1] Production here means production of the forest in the form of growth; that is, forest production equals forest growth of merchantable wood. Production does not mean the cut.

[2] Report Forest Subcommittee, Reconstruction Committee, England, 1918.

Table 1.

Region	Area in millions of acres	Estimated growth per acre per year. Main stand and thinnings. Well stocked stands, in cubic feet	Annual growth per region, i.e., possible annual cut under sustained annual yield, in cubic feet
New England	24.7	60	1,482,000,000
Middle Atlantic	28.7	60	1,722,000,000
Lake States	57.1	50	2,855,000,000
Central	56.7	70	3,969,000,000
East Gulf and South Atlantic	99.0	70	6,930,000,000
Lower Mississippi Valley	78.9	80	6,312,000,000
Rocky Mountains	60.8	40	2,432,000,000
Pacific Coast	57.6	100	5,760,000,000
Totals	463.5	...	31,462,000,000

Note.—Regions and areas of the regions are given by the U. S. Forest Service report on Senate Resolution 311, 1920.

The average cut on all German State Forests (1902) was 18 cubic feet per acre per annum; on ordinary private forests 27 cubic feet.[3]

The total amount of possible annual growth, hardwoods and conifers combined, in the United States, is from the above about 31.5 billion cubic feet. Peculiarly enough, this figure is very close to the estimated number of cubic feet used in this country annually. This is about 68 cubic feet per acre per annum.

It is thus seen clearly that if every acre of forest land in the country were today well stocked with desirable trees, and producing good growth, the total growth would be but little more than the present actual cut. The cut may be said to equal the needs of the nation.

This calculated production is, of course, impossible of actual consummation at present on account of losses through fires, insects, poor stocking, etc. It is obvious, however, that unless the nation uses very much less timber per capita in the future than it does now, despite the best efforts of forestry, this nation must be an importer of timber. Either that, or more land must be put to growing timber. Where such lands can be obtained without dispossessing agriculture, is not apparent. Indeed, it is more likely that much land now considered forest land will, in the future, be used as farm land.

[3] From "Forest Politik" Endres.

Alaska possibly can supply, above its own needs, a total of about 300,000,000 cubic feet of hemlock and spruce annually.[4] This amount is relatively small and can cut little figure in the total needs.

A number of years must elapse, naturally enough, before the cut and burned over forest lands here figured can be brought into the productiveness given above.

This question is pertinent now: If entirely adequate measures of forestry were introduced immediately on all the regions given, how soon could the forest be built up to its full productive capacity? How soon could this come even with the most energetic beginnings and with sustained progress? The number of years, of course, must vary with the seriousness of the retarding factors. For instance, to change an area which is densely covered with undesirable sprout hardwoods, such as have usually followed lumbering operations in the spruce forests of New England, back to the more desirable spruce, is an exceedingly difficult and lengthy task. To replant the sand plains of the Lake States that have been so severely burned year after year that there is now little or no tree growth on them is comparatively simple and easy, and the years before these lands will be producing their full capacity are numbered roughly by the rotation of the species grown.

The figures given below are, to be sure, only estimates, but yet, perhaps, pretty good estimates. They are based on silvical studies made in most of the regions at one time or another by members of the faculty of forestry at Michigan:

TABLE 2.

Region	Years to become fully productive
New England	125-150
Middle Atlantic	125-150
Lake States	100-125
Central	50-100
East Gulf and South Atlantic	50-75
Lower Mississippi Valley	100-150
Rocky Mountains	25-50
Pacific Coast	Probably could get onto sustained annual yield immediately

The above figures throw new light perhaps on the relative urgency of adequate measures of forestry for the nation, that is, measures necessary to prevent further forest destruction.

Forest devastation, as shown by the above, has now progressed to such an extent in the country that it will take nearly a hundred years

[4] Obtained by this approximation: 10,000,000 acres at 30 cubic feet growth per acre per year.

of the best forestry possible before the nation can get onto a sustained annual-yield basis, which will supply enough timber for our needs. "The best forestry possible" means an almost unlimited expenditure of money for reforestation, improvement cuttings, preparation of roads for intensive utilization, etc. The phrase also means that all present forests will be handled on forestry principles (and preferably by foresters).

It is evident that a severe timber shortage, covering a period of fifty to one hundred years, will surely occur. It will be the period between the year when the depletion of the present virgin stands is completed and the year when our rebuilt devastated forest areas come to bearing. There is every reason for believing, too, that the present virgin stands will be practically gone in 1980, as was figured by the United States Forest Service last year.

The outlook for adequate timber supplies of the near future is not very encouraging.

PROGRESS OF FORESTRY IN CHINA IN 1919-1920

By John H. Reisner

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Progress denotes correctly the present condition of forestry in China, this country so long used as an illustration of the dire results that follow the depletion of forests, and undoubtedly in greater need of scientific forestry than any other large country in the world. The year ending with the spring planting, 1920, showed much progress over the previous year, which was described in the author's previous article under a similar title. The outstanding developments of the year were the organization of a Provincial Forestry Service for Shantung Province; the enlarging of the forestry organizations in a number of provinces; the increased activity and services rendered by the Kiangsu Provincial Forest Station at Nanking, established in 1916; the extension of the forestry work being undertaken by three Government railways, namely, Lung Hai, Peking Hankow, and Tientsin Pukow Railroad; increased educational interest in fires particularly as part of the curricula of Government agricultural schools; the increased production of forest nursery stock; and the greatly increased number of district magistrates, agricultural societies, small companies, and individuals undertaking forestry work.

Although a numerical expression of this progress is open to criticism, it is fairly safe to estimate a conservative expenditure for various forestry enterprises mainly nursery work and forest planting at from $200,000 to a quarter million dollars, the production of 100 million trees in over one thousand nurseries, and the planting of twenty-five to thirty million trees on 100,000 acres of land. This may seem small when compared with some other countries, but large when one considers the background and the fact that China's interest in forestry is only a very few years old.

As indicated previously, forestry is not developing in China as it has in western countries, with the Central Government assuming a very large share of financial and administrative control, but by indi-

viduals, societies, or companies, districts and provinces. And this condition may be expected to continue even in face of a marked activity on the part of the Central Government. Individuals, companies, and small political units in China will have from the outset a much more important place in reforestation projects than similar bodies have had in the West. This is an important fact, and augurs well for the future of forestry in China.

The observance of Arbor Day is spreading widely and rapidly and is becoming of increasing significance. It is a national holiday. It is observed by high officials as well as the school children. With the development of the school nursery idea, that is, for the secondary schools to have their own school nurseries, as many western schools have their school gardens, and the children get to raising their own trees, it will add much to the influence of Arbor Day not only on the children but also on the community. Arbor Day is rapidly becoming indigeneous and may be expected to be one of the important factors in hastening forestry development in China.

The outstanding forestry development continues to be that of the Kiangsu Provincial forestry station, started in 1916, located near the famous Ming Tombs in Nanking, at the head of which is Mr. Song Sing-moo, a graduate of the Philippine School of Forestry, with twenty-one assistants, two of whom also received their forestry education in the Philippines. The budget for this work last year was $34,000, voted by the Kiangsu Provincial Assembly and paid wholly by the province through the Provincial Department of Finance. Thirty-four thousand mow of land have been replanted to date with two and a half million of trees, including about one million of trees planted on 11,000 mow of land last spring. Three nurseries were maintained, with an area of 371 mow, carrying 1,275,000 transplants and about 3,000,000 seedlings divided among seventy-three different species. Trees and seeds for nurseries and over 50,000 trees for transplanting and for use in the observance of Arbor Day were distributed to 186 district officials, agricultural societies, agricultural and forestry stations, and companies or individuals. There are three sub-stations already located in important parts of the province with two more being planned for. In response to a proclamation by the Governor two years ago instructing district officials to develop forest nurseries in their respective districts for demonstration purposes as well as for supplying trees for planting to the farmers, encouraging headway has been made, and

a large number of such nurseries have been established. Sixteen students are now being given practical training at the central station in Nanking, having been sent from various parts of the province. They are given class work in the morning and field work in the afternoon, and after three years of such training they will be sent back to carry out forestry work in their home districts.

The newest provincial development has been in Shantung Province, which has come into world prominence through the "Shantung Award" of the Paris Peace Conference. This work was organized by Mr. D. Y. Lin, a graduate of the Yale Forestry School, and at present of the Forestry Department of the College of Agriculture and Forestry of the University of Nanking, an American Missionary Institution at Nanking, China, who loaned him for the work at the special request of the Shantung Civil Governor. A Provincial Forest Service has been established, with a Chief Forester and eleven assistants. Work was prosecuted so vigorously that the first planting season saw the organization of three forestry stations, the establishment of three nurseries with plans for two more for the following season, over 550,000 trees planted on 2,000 mow of land, and an additional 3,000 mow seeded. The budget calls for about $22,000, payable through the Provincial Treasurer.

Three government railways are engaged in reforestation work looking forward to supplying their own ties and other timbers used in railroad construction and maintenance. Several other railways are contemplating similar developments. The budgets are voted by the various railway administrations interested. The forestry work of the Lung-Hai Railway, which is financed by Belgian interests, is under the direction of Mr. J. Hers, with a budget for the year of about $17,000, which maintains a regular staff of about fifty men, including laborers, a large central nursery with three smaller ones controlled by it, in all about 120 mow in nurseries with a million and a half seedlings, transplants, and cuttings. The reforesting has been mostly along both sides of the railway where 4,000,000 trees have been set out, including over 800,000 the past season. The Tientsin-Pukow Railway forestry work has a budget of about $6,000 and is in charge of a graduate of Harvard Forestry School. About 850,000 trees have been planted to date, three-fourths of them this last year. There are two nurseries, one with about 640,000 seedlings and transplants. This work was begun in the last summer of 1918 and is just getting under way. The

Peking Hankow Railway's forestry work is under the direction of Mr. Ngan Han, a graduate of the Forestry Department of Michigan State University. A large tract of mountainous land in Southern Honan is being reforested, and while no detailed report can be given, the work is progressing nicely.

It would require a large volume to give the details of the various district forestry enterprises, which is not the purpose of this article. It should be noted, however, that out of the 1,800 or more districts (counties) in China, probably twenty to twenty-five per cent have their own nurseries, or nurseries administered for them and for the upkeep of which they are taxed. A few instances will indicate this local interest and progress. The Southern Chihli nursery has a budget of $1,600 which is raised by allocating $40 to each of the 40 districts served. The Kao-Yi district of the same province has its own nursery, with a budget of $1,080 which is raised from a local tax on cotton. The second nursery of the Chekiang Forest School has a budget of $1,500, a million and a half transplants and seedlings in its sixty-mow nursery, and has direction over eleven smaller nurseries. The second nursery of Shensi province, with three local nurseries under its direction, has a budget of $2,400, with a production of five million seedlings. This nursery has adopted the policy of giving free to anyone in their nursery area fifty trees and up to five pounds of tree seeds. For larger amounts a slight charge is made. The Kiangsi model Forest plantation with its budget of $1,590 from the provincial treasurer, in its two nurseries, had about 2,000,000 transplants and seedlings and planted out about one-half million trees to the forest site. The Lin-Cheng district (Chihli) industrial deputy with his central nursery and four sub-stations, his budget of $1,350 raised from house and land taxes, and 3,000 mow reforested to date, is planning to have every family plant five trees annually for each male member. The second Chekiang Provincial nursery supplied free of cost over a million trees, to sixteen districts in addition to schools, farmers, and others, from its 190-mow nursery containing more than four million transplants and seedlings, on its budget of $2,931 raised from local taxes.

Records secured from twenty-one forestry enterprises, including large and small, from North and Central China, showed an expenditure for the year under review of $106,000, a production of 26,500,000 seedlings (80 per cent of total) and transplants in the nurseries represented and three and a half million trees planted to forest sites on

15,000 mow of land. From data at hand and from first-hand knowledge, conservative estimates of forestry expenditures and work last year would place the total amount of forest nursery stock raised at 100,000,000 trees, in considerably over 1,000 nurseries, with an expenditure of from $200,000 to $250,000. In addition there were probably between twenty-five to thirty million trees planted out to permanent sites on about 600,000 mow of land (100,000 acres). The largest nursery section is in North Kiangsu around Kangchow, where an investigation showed an annual production and sale of between thirty and forty millions of trees, about one-half of which are pines.

An interesting and encouraging development is in the introduction of courses or departments of forestry into many of the secondary agricultural schools of which every province has from one to five. Anhwei Province is now teaching forestry in four of her five agricultural schools, Chekiang Province has a secondary forestry school with a budget of about $35,000, and a large enrollment. Graduates with forestry training will be in increasing demand, and the more imperative need would seem to be for more highly trained men than secondary schools can turn out. The present forestry education is an important factor in the situation both as it affects forestry personnel and development of an intelligent public opinion on forestry matters.

There is a phase of forestry development in China that America should be proud of, which is, that in practically all the large forestry enterprises men trained under American, or American trained, foresters are in the lead. Graduates of Yale, Harvard, Michigan, Syracuse, and Cornell, of the Philippine School of Forestry, and of the University of Nanking, Nanking, China, whose forestry teachers are Americans or American trained Chinese, are all holding positions of responsibility, and some are holding the highest in the country. A Forest Service in China with as high ideals as the Forest Service in the United States will be irresistible and to it will be entrusted one of China's greatest problems and needs.

A DREAM COME TRUE: MARYLAND LOBLOLLY PINE TO THE FRONT

By Joshua A. Cope

Assistant State Forester of Maryland

We foresters, at least those of us who are not too far removed in point of time or interest from the forest schools, love to think about complete stocking, financial rotations, reproduction cuttings, and other terms in the vocabulary of forest management technique whenever we see an even aged stand of conifers. But deep down we realize that we can't put those thoughts actually into commercial practice until lumber prices advance and utilization becomes more complete.

It was a surprise, then, the other day, to run across an instance of complete utilization on a commercial scale that made forest management not a dream but an actuality in 1921 and the thrill received was so genuine that it seemed selfish not to let others share in the possibilities that the following facts suggest.

Those of you to whom the words "Eastern Shore" call up only sweet potatoes, cantaloupes, and banquet bivalves, I would remind that this same peninsula between the Delaware and Chesapeake is the home of the loblolly pine—a worthy rival of the white pine and slash pine for fast growing honors on the Atlantic Coast. Salisbury, Maryland, a town of about 7,500 population, is situated on the main line of the railroad tapping this peninsula and is the center of the wood-using industries that avail themselves of this fast-growing species for the manufacture of lumber, box shooks, barrel staves, strawberry and cantaloupe crates, as well as veneered containers of all descriptions.

One of the progressive lumbermen of the town had acquired before the late war a 900-acre farm, chiefly covered with mature loblolly pine in mixture with inferior hardwoods such as red maple, black and red gum, and some oak, both white and black. The wooded portion averaged about 14 thousand feet to the acre. This tract is located 6 miles from Salisbury, over roads shelled two-thirds of the way and the rest sandy. The lay of the land being favorable for agriculture, and another shipping point being only 2 miles distant, it did not seem wise to hold this timber any longer because the land, if cleared, would bring $75 per acre for farm purposes.

Late last fall cutting operations were begun, but instead of putting in a portable mill in the woods the owner hauled the logs those 6 miles to a pony band sawmill in town—amid much raising of eyebrows and shaking of heads, to be sure.

He finds his costs per thousand mill scale by this procedure are—

Felling and log making	$2.50
Hauling to Salisbury (wagons loaded in woods)	7.50
Sawing and grading and sticking	6.00
Total	$16.00

But every thousand board feet of lumber yields from one-half to three-quarters of a cord of slab wood, which finds a ready market in town at $10 per cord delivered, or $6 per cord at the mill with no expense for handling. After deducting the trifling cost of converting slab wood into stove lengths, he can credit $4 per thousand against his sawing bill, making the total costs $12; stumpage is figured at $12.50, which is about $2.50 higher than the general price in this section; and the finished product sorted and graded is sold to his planing mill at an average price of $30 per thousand. This makes a net profit of $5.50 per thousand on this operation.

In addition to this, he has been able to supervise the sawing, getting some graded stock whereas in the woods the sticks would have been sawed through and through in one common grade.

This took care of all the merchantable timber on the tract down to a 6-inch top, and in that respect the operation was not very different from similar operations the peninsula over. But there was still on the tract trees too small to be merchantable, inferior hardwoods interlaced with a mass of tops and lops, such conditions as prevent another stand of timber from getting established—a fire trap and a desolation for years to come.

It will be recalled that this land had a sale value for agricultural crops of $75 per acre, if cleared. It was essential then for the owner to figure how to at least break even on the clearing up proposition. This is the result:

He put a crew, under a competent foreman, in the woods immediately after the felling crew, cutting out all tops down to an inch, in any length they would make, cutting down all the hardwoods not taken by the felling crew and making them up in lengths convenient to handle. All brush from these operations was stacked in great piles, as was most

convenient, to be burned at leisure. A man with a rack wagon hauled all the trimmed sticks to a central place where a combination cut-off saw and splitting machine, operated by a 6-horsepower gasoline engine, made stove wood at the rate of a cord an hour, using two men on the splitter. As a result of this work, he has the land ready for harrowing, clear of everything but stumps, and these, especially the pine, will rot in two or three years.

Here are the figures for the work:

Making sticks and hauling to pile, per cord	$2.00
Making into stove lengths (including stacking and splitting)	1.50
Selling price in the woods—	
Pine, per cord	6.00
Mixed hardwoods, per cord	8.00
Average price per cord [a]	7.00

[a] Cord equals 3 14-inch sticks, hence little less than an actual cord.

Average yield, 10 cords per acre, at average $7.000	$70.00
Costs as above	35.00
Profit per acre	$35.00

But you say this isn't forestry for he is converting this land to agricultural uses. My point is just this: This operator has demonstrated that taking a place 6 miles from the market he can go in after most lumbermen are through and get $35 per acre for clearing up the land. This land happened to be chiefly valuable for agriculture, and hence it very properly should be converted to that use. There are, however, hundreds of acres of 6-mile land that are directly away from the railroad and hence not worth $15 per acre, which are, on the other hand, accessible by roads as good or better than the one in question. Here the land can be restocked to pine by planting either wild or nursery stock at an outside cost with labor at $2.75 per day, of $12 per acre, and the owner is still $23 per acre to the good.

FIRST RESULTS IN THE STREAMFLOW EXPERIMENT, WAGON WHEEL GAP, COLORADO

By Carlos G. Bates

Director Fremont Experiment Station

It is nearly ten years since the first outline of the Wagon Wheel Gap streamflow experiment, started jointly by the Weather Bureau and Forest Service in 1910, was given to the Society. These ten years have been years of suspense not only for me, but, I am sure, for many other members of the profession, who have awaited the results of the first serious effort to obtain, under experimental conditions, a quantitative expression of forest influences on snow-melting, streamflow, and erosion.

The period up to July 1, 1919, was devoted entirely to the refinement of the technique, and the establishment of relations existing between the two streams while *both* were influenced by forest cover. For these relations we have eight years' reliable records. Denudation of one area (Watershed B) was begun in July, 1919, and completed by the burning of most of the brush and débris in September, 1920. As the "streamflow year" begins October 1 and ends September 30, we now have a record for one whole year, in which the forest has been almost completely destroyed, but the absorbing capacity of the forest floor has been little changed. While the results in this year may not be as significant as those to follow, and the average results for several years must be taken for the basis of any broad calculations, it is felt that these first results will be extremely interesting, and therefore, with the consent of the Weather Bureau, the following unbiased statement is given.

It should be remarked that each of the following calculations is made according to formulæ (expressed by diagrams) derived from the eight years' record prior to denudation, and agreed upon by the two Bureaus as showing the most probable relation of the two streams under forest influences, for various climatic conditions. These formulæ are not perfect, and improvement in them may be made as time goes on. As at present accepted, they will shortly be published in the Monthly Weather Review.

With these formulæ, we calculate the "most probable" discharge of stream B for any period in the year, and for conditions existing with forest cover, and compare this quantity directly with the actual discharge after denudation.

For the general conditions of the experiment, the reader is referred to my article in the Proceedings of the Society of American Foresters, Vol. VI, No. 1, 1911. Some discussion of this project has also been given by Zon,[1] in comparing it with the Swiss Experiment, whose results are recently available.

CALCULATIONS BY PERIODS[2]

1. Relations for the whole year, October 1, 1919, to September 30, 1920:

The precipitation and run-off of both streams is rather larger than in the average year, especially in the spring flood period.

Under the conditions existing, the most probable discharge of stream B, with forest cover, would have been 7.608 inches over watershed.[3]

[3] Corresponding, say, to 22 inches of precipitation over the watershed. This expression permits us to disregard the area of the watershed. Hereafter the abbreviation "ins. O. W." will be used.

The actual discharge was 8.566 inches.

Gain from removal of forest .958 inches or 12.6 per cent.

2. Relations in the spring flood, 1920:

(a) First day of flood on A:

The streams rose steadily from their winter rate without any marked cessation of snow-melting.

Stream A first passed into the flood stage on April 8.

The most probable discharge of B, on this date, for the conditions existing would be .0114 ins. O. W.

The actual discharge was .0165 ins. O. W.

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[1] Zon, R. The Effects of Forests Upon Streamflow. Review in JOURNAL OF FORESTRY, XVIII, 6, October, 1920, p. 625.

[2] The Weather Bureau concurs in the statement of the preliminary calculations of streamflow.

It wishes to state, however, that in a number of respects the winter snowfall cover, its melting, and the general flood conditions for 1919-20, place this year in a class by itself, to some extent, as giving conditions more or less unlike corresponding conditions prevailing in the first stage of the experiment and before Watershed B was denuded.

The rate for this day was increased 44.6 per cent by early snow melting induced by denudation.

(*b*) *End of flood on A (July 13):*

Under the conditions of subsidence of the flood the most probable discharge of stream B for the end of the flood (3 days, including one before and one after the last technnical day) would be .0421 ins. O. W.

The actual discharge was .0443 ins. O. W.

The stream was still 5.4 per cent higher than it probably would have been under the influence of forest.

(*c*) *Crest day on stream A:*

Under the conditions leading up to the crest of the flood, the discharge of stream B, on the highest day for A, should have been .2265 ins. O. W.

The actual discharge was .3105 ins. O. W.

At this point the rate of discharge was 36.9 per cent higher than under forest conditions.

(*d*) *Time elapsing between crests:*

Under forest conditions the crest of B was always somewhat later than that on stream A.

Under the conditions in 1920 it should have been, and *was,* one day later than the crest on A.

It would seem, then, that while earlier melting on watershed B had produced a relatively large early flow, the time of maximum melting was not appreciably affected.

(*e*) *Relative height of B crest:*

Considering the height of stream B on the crest day for A, it is found that on its own crest day (the day following) stream B is depressed about 5 per cent. This is the first evidence of any reduction in the supply to stream B resulting from early discharge.

(*f*) *Total volume in flood:*

The most probable total volume to be discharged by stream B, considering the character of the flood, was 5.195 ins. O. W.

The actual volume discharged was 5.946 ins. O. W., or a gain of 14.5 per cent. It is thus evident that greater flow in the early stages of the flood was not compensated by decreased flow in the later stages. In fact, we have already shown that at the end of the flood stream B was still 5 per cent high.

(*g*) *Volume to crest of flood on A:*

In this first period (16 days out of a total of 97 for the whole flood) the most probable discharge of B was 2.115 ins. O. W. and its actual discharge 2.727 ins. O. W., or an excess of 29 per cent.

Rough calculations indicate that on some days in the early stages of the flood stream B may have discharged 100 per cent more than would have been expected under forest conditions.

3. Relations in the summer rainy period:

(*a*) *From end of flood to July 31:*

In this 18-day period the flow of stream B was 0.242 ins. O. W., or only 0.8 per cent above that to be expected.

(*b*) *Month of August:*

The discharge of stream B was .311 ins. O. W., or 2.1 per cent in excess of the expected.

(*c*) *Month of September:*

The discharge of stream B was .331 ins. O. W., or 1.4 per cent in excess of that to be expected, all things considered.

(*d*) A check on the three preceding calculations, by one calculation for the whole period, shows no appreciable correction to be applied to the months. This shows an excess in the discharge of B of 2.8 per cent for the whole period.

(*e*) *Last five days of September:*

This period is almost always rainless and permits us to examine the relation of the streams when not influenced by any current precipitation. In 1920 all of the 5 days were without rain.

Calculations for 1920 indicate stream B was running 2 per cent above the usual, at this time.

4. Relations for the period October 1, 1919, to beginning of flood in 1920, the freezing period:

Admittedly, in the effort to cover this long period by one calculation, only a rough approximation to the most probable flow of stream B is possible. Unless a number of years' results give very consistent effects ascribable to denudation, it will be necessary to devise formulæ for different parts of the winter period. The whole, however, is to be thought of as one for the storing-up of water for the next growing season.

By the tentative formulæ, then, the most probable flow of stream B for the period was 1.754 ins. O. W.

The actual discharge was 1.707 ins., or a deficit of 2.7 per cent.

By deducting from the most probable for the whole year, the calculated amounts for the flood and summer periods, the result is entirely different. The most probable discharge of B is then 1.523 ins. O. W. and the actual of 1.706 indicates an excess of 12 per cent.

It might be remarked in defense of the latter figure that calculations by another set of formulæ, showed the flow of B from August, 1919, to January, 1920, to be steadily in excess of the most probable flow under forest conditions.

However, for the present, we are unable to make any positive statement as to the effect of denudation in this least important period of streamflow.

5. Silt deposits in basins as a measure of erosion.

The provisions for measuring the detritus carried by the streams are entirely adequate so far as mineral soil is concerned, but in flood a very appreciable quantity of organic silt may escape.

Individual silt measurements in the period of comparison of the two streams under forest, showed wide fluctuations, so that the calculated ratio of B silt to A silt for any single period has only approximate value.

However, the results in this first year are so striking as to leave little doubt. It should be remembered that they have been secured *without* destruction of the humus by fire, and represent, in all probability, results of disturbance in logging the watershed.

RECAPITULATION

The calculations of streamflow for one year after denuding the watershed known as "B," but before destroying the ground cover by

Period	Amount for A	Most probable for B	Actual for B	Excess
	Lbs.	*Lbs.*	*Lbs.*	*Per cent*
July 15 to October 15, 1919.......	75.6	130.	58.6	55
October 15, 1919, to April 15, 1920..	117.9	92.	131.3	43
April 15 to July 15, 1920.........	362.5	400.	1211.0	203
Whole year....................	556.0	622.	1400.9	125

SUMMARY

Datum.	Most probable discharge under forest protection	Actual discharge after denudation	Gain in flow from denudation	
	Inches	*Inches*	*Inches*	*Per cent*
1. Total for the year, 10/1/19 to 9/30/20	7.608	8.566	.958	12.6
2. Total for spring flood, 4/8 to 7/13/20	5,195	5.946	.751	14.5
3. To crest of flood, 4/8-5/23.....	2.115	2.727	.612	29.0
4. After crest of flood (by differences, 2-3)..............	3.080	3.219	.139	4.5
5. July, after end of flood.......	.240	.242	.002	0.8
6. August	.333	.341	.008	2.4
7. September	.317	.331	.014	4.4
8. Whole summer, by sum 5, 6, 7.	.890	.914	.024	2.7
9. Whole summer, single calculation	.888	.914	.026	2.9
10. Fall and winter freezing period, 10/1/19 to 4/7/20......	1.754	1.707	-.047	-2.7
11. Total for year, lines 2, 5, 6, 7, 10......................	7.839	8.567	.728	9.3
12. Fall and winter, by differences (line 1 minus 2, 5, 6, and 7).....................	1.523	1.706	.183	12.0
13. Whole summer, June 1-September 30..................	2.282	2.362	.080	3.5
Critical rates:				
14. First day of flood, 4/8/20.....	.01140	.01650	.0051	44.6[a]
15. Day of crest on A, 5/23/20....	.2265	.3105	.084	36.9[a]
16. Last day of flood, 7/13/20....	.0421	.0443	.0022	5.4[a]
17. Last 5 days September, rainless	.0554	.0568	.0014	2.0[a]

[a] These percentages are obtained from the original calculations in terms other than ins. O. W., the transposition of figures slightly altering the results.

fire or removing a narrow strip of timber on either side of the stream-channel, when compared with the most probable flow of this same stream, for conditions of the year as evidenced in climatic records and the flow of a second stream, show the following facts which may or may not be duplicated in succeeding years.

1. Removal of the forest cover had the effect of causing earlier melting of the snow and a higher rate of flood discharge during the entire flood period from April 8 to July 13, 1920. The excess of flow was most marked in the early stage of the flood and least important at the end. It amounted to 14.5 per cent for the entire flood period.

2. During the latter half of July the stream from the deforested area was nearly normal. In August and September, however, its flow increased slightly, probably both on account of larger direct contributions from rains, and because the loss of a storage water through the transpiration from leaves was minimized. At the end of September the stream was flowing 2 per cent above its expected rate.

3. Whether the stream flowed more or less than it would have done under the influence of forest, during the fall and winter period, is problematical.

4. There was an excess of 125 per cent in the amount of measurable detritus carried by the stream after the forest removal. Most of this was secured during the flood quarter.

5. Expressing the late flood and summer conditions as one quantity, it may be said that the removal of the forest made available .08 inches over the watershed, or .0067 acre feet per acre of watershed, which would not otherwise have been available during the period June 1 to September 30. This is to be balanced against more than .05 acre feet which came down as flood excess too early to be of value in irrigation, and against the 125 per cent increase in detritus.

SCIENCE VERSUS TRADITION IN GAME PROTECTION

By Ward Shepard

Forest Supervisor, U. S. Forest Service

Game protection in America has always revolved round three traditional principles: bag limits, universal open or closed seasons, and unlimited sales of licenses. Roughly, the increase of hunters, as indicated by license sales, has supposedly been offset by reduced bag limits, shorter open seasons, or closed seasons extending over several years. These traditions have had a powerful influence in American game legislation, and it is only in recent years that game protectionists have been able to break through them.

Although it can be admitted that these principles have slowed down the tide of wild life destruction, they no longer meet the needs of twentieth century America, with its ever-lengthening mileage of good roads, its automobiles, its powerful weapons, and its growing enthusiasm for a life in the open. The last wildernesses will in a few years be the camping and hunting grounds of hosts of pleasure seekers.

Bag limits and open or closed seasons have almost universally been fixed by State legislatures and for whole States. Long closed seasons have rarely been established when a species was becoming merely depleted, but has waited until the species was nearly extinct. Accessible game ranges have been wiped clean of game; hunters have gone farther and farther afield in search of game, and only when game was making its last stand has the public conscience been roused to drastic and often futile modes of protection.

In New Mexico, the buffalo and the elk were long ago exterminated. There is one pitiful band left of the great flocks of mountain-sheep seen by Coronado, and even these suffer periodic raids from civilized head-hunters. It is doubtful if any means can save the remnants of great antelope herds from annihilation. Wild turkeys and deer have been wiped out from vast areas of their native ranges; but thanks to their recuperative powers, they can be saved and increased.

These tragic facts in the history of wild life can be duplicated in almost any State in the Union. In the Middle West, sportsmen bicker

with legislatures on the rabbit and bob-white seasons, or take to trap-shooting. Daniel Boone, if he should revisit his old hunting grounds, might die of starvation if he depended on game for his food.

These old principles of game protection compare with scientific game management as a rough diameter limit in logging compares with forestry. Just as various species of trees in various localities demand varying silvicultural treatment, so the different species of game, subjected to all degrees of persecution in their various ranges, need varying degrees and modes of protection.

New Mexico has gone in for a new method of game protection. It has created a game commission with broad regulatory powers, so that the slow, laborious processes of legislation are not needed in order to apply protection when and where it is needed. This commission is empowered to create game refuges, to purchase lands for refuges or public shooting grounds, to establish closed seasons on any species of game or fish at any time or place, to close the hunting season during times of extreme forest fire danger, to establish rest grounds for migratory birds, to establish and operate fish hatcheries, to propagate, buy, sell and plant any species of game or fish, and to establish such service as may be necessary to carry out these powers within the limitations of its financial resources.

The establishment of game refuges and of local closed seasons where game is badly depleted are the two essential factors in maintaining a breeding-stock, and the maintenance of a breeding-stock on every range suitable for game is the very foundation of game management. Because it failed to maintain a breeding-stock, the old system of game management signally failed to perpetuate game. One of its most conspicuous failures was with migratory birds. The conspicuous success of the Federal migratory bird law lies in its insistence on maintaining the breeding-stock by eliminating spring-shooting, when the birds are mated and preparing to rear their young. That, however, is only half the problem; for the next danger to waterfowl lies in the destruction of their breeding-grounds through drainage, and this danger the United States Biological Survey is seeking to avert through Federal acquisition of breeding grounds by a tax on migratory bird licenses.

What the migratory bird law is accomplishing for waterfowl by recognizing this fundamental principle, State game laws have largely failed to achieve for other game by ignoring or slighting the principle, or at least by failing to create effective means for putting it into effect.

These laws have permitted the destruction of entire species by failing to give them breeding grounds. The overwhelming need of game in America is an adequate system of game refuges—not great game preserves to serve as museums of living specimens, though these are admirable in their proper place, but numerous small refuges intended for game production, the surplus to be hunted on adjacent game ranges. The number of these refuges must be in inverse ratio to the scarcity of game and in direct ratio to the abundance of hunters. To supplement this system of fixed, permanent, inviolate refuges, there should also be provision for flexible local closed seasons where breeding-stock is reduced below the possibility of recuperation through refuges.

For nearly two decades game conservators have made strenuous attempts for a Federal law authorizing the President to establish game refuges on the National Forests. They have failed so far. Meanwhile legislation like that just adopted in New Mexico will give an opportunity for close and effective co-operation between State and Federal officials in game management. It has the added advantage of throwing the responsibility for wise game management on the State, where there is a vast amount of public sentiment in favor of game protection. There is no good reason why advantage can not be taken of this popular sentiment in other Western States to get away from ineffective tradition to real management. One State—Montana—under the leadership of Governor Dixon, is already working for legislation similar to the New Mexico law, and it is not an impossible dream to hope that through wise legislation the big game of the West may be in reach of safety within the next decade.

TWO RACES OF ASPEN

By F. S. Baker

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In the mountain ranges running north and south through the State of Utah, apsen (*Populus tremuloides*) is an exceptionally common tree at middle elevations, covering large areas with solid bodies of pure type, particularly in the Wasatch Mountains and the Wasatch and Fishlake Plateaus.

In the spring when the leaves are unfolding it is commonly noted that the leafing time of adjacent bodies is quite dissimilar. Not infrequently a line can be traced for upwards of a mile through the aspen where on one side the leaves are half developed and on the other the buds are just bursting. This line is almost invariably clear cut and distinct with little intermingling of the two forms. The boundary is apparently not determined by topography or soil conditions, as it may run up and down slopes or across them, or perhaps more frequently it will pursue a serpentine course entirely independent of topography.

While spring leafing is the most striking feature in which these two forms of aspen differ, there are also other characteristics which are apparent. The leaves on the trees which come out first last longest in the fall, as a rule, although there is less consistency in this manner than spring development, due apparently to the very uneven action of frosts in a mountainous country.

Furthermore the trees that leaf out earlier than their neighbors are characterized by a somewhat yellowish or brownish tinged bark in contrast to the pure white or light greenish tinged bark of those that leaf out later. The difference is least pronounced at lower elevations where it may be almost imperceptible, but higher in the mountains the difference is much more marked, the "yellow" trees taking on a much deeper cast. The "white" trees seem to be more widely distributed at low elevations, while the highest bodies that run up almost to 10,000 feet as thickets of scrubby trees, are almost invariably "yellow." As a rule, when seen side by side the "yellow" trees appear

to make somewhat [illegible] height growth [illegible] form than the "white." Measurements [illegible] grounds of the Great Basin Experiment Station [illegible] only .03 inch in the diameter of the "white" and "yellow" [illegible] ever, in favor of the "white," while the finest stand [illegible] the Great Basin Experiment Station is "yellow" [illegible] of aspen in an Engelmann spruce [illegible] difference in development worthy of practical [illegible].

The cause of these two races is not clear. [illegible] seems [illegible] to soil, or conditions of growth, nor does it seem to be [illegible] with the sex of the trees. The "white" trees flower [illegible] much more generally than the "yellow" trees, as far as observed, but "yellow" trees are also occasionally seen with catkins. Flowering is infrequent in either class. Pistillate flowers are extremely rare, having been found for example in only one small locality in [illegible]. These few trees are "yellow" (early leafing).

In many places where the line between the two forms runs out into a treeless opening, the front of the aspen type edging the opening is not even, but has a considerable indentation where it is intersected by the line dividing the two forms. The appearance gives the impression that the "white" trees and the "yellow" trees spread out from independent centers and finally joined to form one solid body.

The writer confesses an entire inability to explain the cause of these two widely distributed, but distinct and closely intermingled races of aspen. This article has been written in the hope that it might evoke comments from others who have noted the same two races with different leafing periods and bark characteristics, which might throw further light on this interesting condition.

PROPERTIES OF WOOD

A Chapter From Lucien Chancerel's Botanique Forestiere

Translated by Winifred Whaley

The relation between the biological properties of wood on the one hand, and its physical, mechanical and chemical properties on the other, is often neglected both by biologists and engineers; the former because of lack of knowledge of mechanics, the latter because of lack of knowledge of biology. The following views on properties of wood from the standpoint of a biologist may therefore be of interest. They are reproduced almost literally from "Botanique Forestière," by Lucien Chancerel.

Color.—The color of woods varies greatly. In some species the heart and sap wood are colored differently so that they can be distinguished in this way. In others this distinction is not apparent. The polishing qualities of woods are also very variable; in some the polish has a satiny appearance, in other variegated.

Odor.—Woods have distinctive odors due to essential acids or oils, which are often characteristic of a species. Odor also often indicates alterations in the wood, for instance, the presence of worms.

Hardness.—Hardness is the quality of woods which measures the resistance they offer to usage, splitting, compression, shock, and the penetration of nails. The following degrees of hardness may be distinguished: hard woods, such as oak and hornbeam; semi-hard woods, as birch and alder; soft woods, as basswood, poplar and willow; and resinous woods. The hardness of woods is in proportion to their specific gravity.

Density.—Density in broadleaf woods, like hardness, is generally in direct proportion to the thickness of the annual rings. This is explained by the fact that in broadleaf species growth produces mainly the elements of autumn wood, which are the thickest and most lignified. On the other hand, density and hardness in resinous woods are in inverse ratio to the thickness of the annual rings, because in these woods growth

Précis de Botanique Forestière et Biologie de l'Arbre by Lucien Chancerel. Paris, 1920. Pp. 145-157.

produces mainly the elements of summer wood, which are less thick and less lignified.

Effect of Site Upon the Mechanical Properties of Wood.—The site most favorable to the growth of a species furnishes the maximum hardness and density, hence the maximum utility. The same is true of the resistance of wood to compression and rupture, which varies according to the specific gravity. This has been proved by tests of eucalyptus, whether grown in Australia or in France; of fir from both plain and mountain; of eastern white pine, both in America and France, etc. Specific gravity is a function of soil quality. Good soil generally produces hard, heavy wood. The specific gravity varies, of course, with the species. It also varies with temperature, hot climates producing the densest and heaviest woods. Resins and coloring matters increase specific gravity. Sapwood is usually lighter than heartwood, the average difference being 6 per cent. An open stand (light) increases the density and hardness of woods, and these qualities are also affected by the time of felling. Woods are harder and heavier if cut when the sap is not circulating. The greatest density of a tree is at the root collar; hence wood from this part of the tree is most in demand for fuel.

Effect of Management.—Management—that is, the method of growing trees—has a certain influence on the density of the wood. Thus, in resinous trees, the proportion of spring wood is in direct ratio to growth activity. Since turpentine is found especially in autumn wood, it is the slow-growing trees that are richest in resin, and densest. In broadleaf woods, on the other hand, growth of the annual layer takes place in the autumn wood, thus favoring the density of the wood. For instance, isolated oak is denser than oak grown in a dense stand; here the quality of the wood is in direct proportion to the thickness of the annual rings.

Swelling and Shrinkage of Wood.—Wood swells in air saturated with moisture, and shrinks in dry air; that is, the walls of the cells swell and shrink. If evaporation is rapid, cracks appear; the wood warps. In passing from the green to the dry stage, wood shrinks at the rate of 0 to 1 per cent lengthwise, 3 to 5 per cent on a radius of the cross section, and 6 to 10 per cent in circumference. Thus shrinkage lengthwise is very slight, and tangential shrinkage great. This causes small cracks or large centripetal cracks. Heartwood contains less water than sapwood, hence warps less. Resin decreases

shrinkage of woods; thus species containing a large amount of resin warp less than the others. In order to avoid deformation of pieces of wood due to shrinkage, the bark must be left on, or the trees cut up after they are dried.

Heat Conductivity.—Expansion of woods under the action of heat is considerably less than that of metals and even of glass. Wood is a poor conductor of heat, but its conductivity is greater lengthwise than radially. Heavy woods, being less porous, are better conductors than light woods.

Conductivity to Electricity.—Wood is an insulator of electricity, and this quality is more pronounced in proportion to the lightness of the wood. The more moisture wood contains, the more readily it conducts electricity; hence the more moisture trees contain the more likely they are to be struck by lightning.

Sound is conducted readily by normal wood; on the other hand, the presence of fungi or worms can be detected by the failure of the wood to conduct sound.

Wood is readily penetrated by X-rays.

Wood Elasticity.—The elasticity of wood is its capacity for being bent without breaking. The maximum of elasticity is found in green, sound wood, its minimum in completely dried wood. Dry woods regain their elasticity when dipped in hot water or subjected to the action of steam; the process of curving or arching pieces of wood is based on this fact. Among broadleaf species, rapidly growing trees are more elastic than slow-growing trees; therefore broadleaf trees from a coppice with standards are more elastic than those from high forests. The opposite is true of resinous species. Trees growing in fresh soil with northern exposure are usually more elastic than those on other exposures. In sawed timbers, resistance is greater in the radial direction than in a direction tangential to the ligneous layers; hence the superiority of timber sawn perpendicular to the medullary grain (débit sur mailles). The elasticity of wood is shown by its resistance to bending. This resistance is measured mechanically by the *load of rupture*. For a single species, elasticity varies with conditions of growth, and is not in proportion to the density of the wood. Resistance to crushing is also measured by the load of rupture, and varies with conditions of growth. It increases in proportion to drying, an important consideration for mine timbers. Aleppo pine, among others, is remarkable for its resistance to crushing, and for

this reason it is excellent for mine timber. Resistance to tension, like resistance to crushing, varies according to species.

Splitting.—The splitting quality is greater in straight fibred woods free from knots. Temperature also affects this property; below 0 degrees, wood splits with difficulty. Heat and moisture both favor splitting. Hard woods are more difficult to split than soft woods, and trunk wood splits better than branch wood.

Durability.—The durability of woods varies with species, with environment, and with antiseptic substances which they contain, either naturally or by impregnation. Sapwood lasts a much shorter time than heartwood. Coppice oaks last longer than those grown in a high forest. Immersion in water removes alterable substances from wood and increases its durability.

Combustibility.—Combustibility is the capacity of wood to catch fire at 300° (Cent.) when in contact with the air. Resinous woods, because of their resin, and soft broadleaf woods, because of their porosity and their oxygen content, burn more easily than hardwoods. The more carbon and the less hydrogen wood contains, the more ash it gives. This is true of black, Scotch and maritime pine. The available heat-producing effect of dry wood is only 39 per cent of the total heat produced by combustion; about two-thirds of this heat is lost. Soil and exposure influence the heating quality of wood. Thus, oak growing on limestone soil is of superior heating quality; the heat-producing capacity of woods grown on southerly or easterly exposures is greater than that of woods exposed to the west or north. This quality is greater in branch wood than in log wood, and its maximum is found in stump wood. The heat-producing capacity of woods is nearly in proportion to their density, and the heat-radiating capacity is greater in hard woods than in soft and resinous woods. It is uniform for all woods when broken up into small pieces. Bakeries, glass factories and pottery factories require wood which burns quickly and at high temperature, such as resinous wood, aspen, alder, birch, linden; on the other hand, slow-burning woods with high radiating power, such as oak, hornbeam and beech, are preferred for domestic uses.

Characteristics of Different Species.—Hardwoods contain much autumn wood—that is, much fibrous tissue. They have a horny appearance and are fine grained, taking a high polish. Pedunculate oak growing in coppice with standards on tertiary or quaternary alluvial deposit produces hard, dense, elastic wood, resistant to crushing, but

likely to warp. Soft woods contain much spring wood. They are dark colored and coarse grained and do not take polish well. They crack and split easily. Oaks growing in high forest on rocky soil produce soft, easily worked wood.

Chemical Composition.—The chemical composition of freshly cut wood with the bark still on averages as follows: hygroscopic moisture, 40 per cent; ash, 1 per cent; elemental constituents, 59 per cent. The amount of water contained in wood varies with the different species and with the time of felling. It also varies in different parts of the tree. In winter wood contains at least 10 per cent of moisture. Young wood contains the greatest amount; then the branches, and lastly the trunks, which contain the least.

Wood is composed chemically of cellulose and vasculose. Simple cellulose ($C_{12}H_{10}O_{10}$)$_7$ is soluble in Schweizer's liquid. Vasculose ($C_{19}H_{12}O_{10}$) is more abundant in heartwood than in sapwood, and in hard woods than in soft and resinous woods. This is the incrustation substance of wood. In distillation it furnishes the greater part of the acetic acid and the pyroligneous acid: This substance decomposes under the action of atmospheric oxygen and nitric acid, causing wood to deteriorate when exposed to air.

Vegetable tissues contain soluble ferments or diastase. Among these are: amylose, which changes starch to dextrine; pectose, which changes pectin to pectic acid; pepsin (in the latex of the fig and the juice of the pawpaw); emulsin (in the almond, bay cherry, sorbus); saponin, which changes oil to glycerine and fatty acids.

Other substances found in plants are: starches, the reserve stuff on which young shoots live; organic alkalies, as quinine, caffeine, theobromine; reserve matter, abundant in certain palms and producing starch sediment; gums, as in acacia; fatty substances, as the oil contained in olive, palm and nuts; glue, produced by a reserve substance called viscine, as found in holly bark and in the mistletoe berry; camphor, in Dryobalanops and Cinnamorum camphora; and sugars, for instance, glucose, saccharines, mannites (ash, maple), pinites (pines), quercites (oaks). These sugars are produced by the conversion of starch into dextrine, then into glucose; they are abundant in the sap of the American Negundo aceroides. There are also the melitose of the eucalypts, the melezitose (galactan?) of the larches, the dulcite of the spindle tree, and the sorbite of the Sorbus species. Ligneous tissues also contain glucosides, such as salicin, in willow; betulin, in birch,

which is combined with tannin in the manufacture of Russian leather; phlorizin in fruit trees; esculin in chestnut; coniferin in spruces; and fraxin in ash. Tannins are found in barks; organic acids, such as gallic acid, in oak and chestnut; acetic acid; oxalic acid (especially in the form of oxalates); carbides of hydrogen, such as essences or resins (benzoin, styrax). Among carbides of hydrogen should be mentioned caoutchoucs. These are obtained from Ficus elastica of the Indies, from Castilloa elastica of South America, Ficus Vogelii of Senegal and Soudan, or from shrubs like Kickscia elastica of Guinea, or vines like the Landolphia, Carpodinus and Calotropis of Senegal, Guinea or Madagascar.

Gutta percha is also found, as in the Palanquium gutta of the Malay Peninsula and Borneo, and in the Mumusops balata, one of the Sapotaceae of the lower Orinoco. The best caoutchouc is the para of Brazil, extracted from Hevea and Siphonia, of the family of Euphorbiaceae. Latex, or vegetable milk, is an edible extract, such as the latex of the Brosimum utile of America.

Among the most widely distributed substances found in ligneous vegetation is starch, which holds first place as a reserve food matter. It is found in all the tissues of the trunk and roots, appears under as many different forms as there are species, and in a single species it differs according to its location in the pith or in the other tissues. The quantity varies with the season. Starch appears in spring in the ligneous tissues (parenchyma), becomes more abundant in summer, and reaches the maximum in the fall. It is reabsorbed at the end of autumn, and appears again in March, being at the minimum in winter. The nature of the soil affects the time of the appearance of starch. Thus, in dry soils, it appears more rapidly and in larger quantities than in wet soils. Mineral fertilizers affect the production of this important substance. Thus potassium compounds hasten the formation of starch, and also tend to bring about rapid development of fruit. It may even be said that they hasten the growth of fruit for the very reason that they form starch rapidly. There is a remarkable correlation between these two phenomena. Starch is more abundant in branches bearing fruit than in other branches. Moreover, in cases where starch is to be formed, potassium seems to be the favorite stimulant. It gives the best results in the formation of tuberous roots, especially potatoes.

Certain plant cells produce oxalic acid; when calcium salts are present, if they are distributed throughout the tissues of ligneous plants, this acid forms oxalate of calcium. It is found in the bark, and especially in the inner bark. Its development with the advancing season is the same as that of starch, increasing from May to October; but it is already present in fairly large quantities when starch has hardly begun to form.

One of the most important and abundant of the glucosides in ligneous plants is tannin. It is an important product of the bark of oak coppice. It is found in solution in the cellular fluid, or in the form of minute intra-cellular masses, as in the bark of oak, poplar and birch. Tannin in fruits may be considered as a reserve product, since it is transformed into glucose, while in the barks and young wood of ligneous plants it is a product of elimination. Its maximum quantity is reached in summer; it forms about one-fourth the weight of gall nuts, spherical excrescences resulting from the boring of synips in the oak. It has been proved that young oaks with smooth bark, that is, in the best state of growth, furnish the largest quantity of tannin.

Wood ash varies with the soil and with conditions of growth. The proportion in weight of soluble salts (chiefly potassium salts) contained in the ash is about 18 per cent. The following bases are found in the ash: lime, 56.73 per cent; potash and soda, 16.81 per cent; other oxides, 2.08 per cent; and acids: phosphoric, 9.44 per cent; sulphuric, 2.50 per cent.

Lime and silica are found principally in the bark; potassium in the leaves and wood. The parts of the tree containing the largest percentage of ash are, first, the leaves and the root hairs, then the bark, the branches, the trunk, and lastly the roots.

Chemical analysis of the tree gives carbon, hydrogen and oxygen gases; nitrogen, sulphur, phosphorus, chlorine, silicium, potash, calcium, magnesium, iron, sodium, and sometimes aluminum ash.

Many other substances have been discovered in plant tissue, the properties of which cannot be determined by chemical analysis.

REVIEWS

Growth Studies and Normal Yield Tables for Second Growth Hardwood Stands in New England. By J. Nelson Spaeth. Harvard Forest, Bulletin No. 2, pp. 21, figs. 2. Harvard University Press, 1920.

This is a most welcome addition to our knowledge of growth and yield. It is particularly valuable since it deals with second growth hardwood stands which, as the bulletin states, "have thus far received but little attention." The bulletin is based on the actual volumes of fully-stocked, natural stands in North-Central Massachusetts. The yields are the minimum to be expected under forest management.

Forty-eight sample plots were measured—all in fully-stocked stands of even age. The plots were chain-wide strips and either one-half or one-quarter acre in size. Trees were calipered down to two inches. Heights were taken by crown classes. In age, the plots ranged from 17 to 75 years.

Forty of the plots are in "better second growth hardwoods," further divided into sites I and II on the basis of average height of dominant trees. The remaining plots are in "inferior second growth hardwoods." In the former, red oak constitutes from 20 to 27 per cent of the trees, white ash 14 to 15 per cent, red maple 12 to 15 per cent, and yellow birch 8 to 10 per cent.

In the inferior hardwoods, gray birch is 38 per cent of the stand, red maple is 24 per cent, and poplar 15 per cent. By careful selection of plots error due to the presence of chestnut was reduced to a small percentage.

Under the heading "Increment" the bulletin says "Properly included in yield tables, but easily derivable from data given, increments are omitted in order that the tables may not prove cumbersome." This was an error in judgment. As Bentley points out ("Forest Management," Wiley & Sons, N. Y., 1919, Art. 71), "the chief uses of yield tables are . . . (3) to make comparisons between the actual current annual increment or mean annual increment of a given stand and the normal increments as shown in the table." Another advantage is in determining the economic rotation (that of maximum average volume production) which coincides with the culmination of the mean annual

increment (Ibid., Art. 93). An examination of the table for yields in cubic feet and cords shows that the mean annual increment of better second growth hardwood stands is as follows:

Age, years	Mean annual increment per acre—Cords	
	Site I	Site II
20	0.790	.....
30	.992	0.680
35	1.000	.728
40	.991	.733
45	.978	.734
50	.960	.719
60	.925	.685

From this it appears that the M. A. I. culminates at 35 years on Site I and at 40 years on Site II. This agrees with previously published figures for second growth hardwood stands. (Bul. 96, Forest Service, U. S. D. A., Tables 30, 32, and 33.)

The bulletin concluded with the interesting observation that "even-aged second growth hardwoods on similar sites have much the same form regardless of species. . . . If this is true, the present tables should be capable of wide use both in the determination of the present and future yields of individual stands, and in more general computations relating to the stand and growth of hardwoods throughout the region."

Mr. Spaeth is to be commended for a scholarly bit of research work and the Harvard Forest for this high grade publication. A. B. R.

Report of the Forester for the Fiscal Year Ended June 30, 1920. U. S. Department of Agriculture, Forest Service.

The annual report of Col. Greeley, the new Forester, emphasizes the need for a national forest policy to solve the problem of the increasingly large area of idle devastated private land. To stop this devastation he suggests a Federal law with two main provisions: (1) Comprehensive plan of Federal co-operation with the States in fire prevention, and the development of forestry practice, and (2) extension of the National Forests through purchases along the line initiated by the Week's Act, etc. Col. Greeley emphasizes the fact that notwithstanding a depleted and overworked personnel the *gross receipts* for the Na-

tional Forest exceeded those of 1919 by $435,067.42 and set a new high mark of almost $5,000,000. It is interesting to note that in British India for the same period the *net revenue* of Indian forests (which occupy a smaller area than our National Forests) was about $6,000,000 above expenses, whereas in the United States the net receipts over the cost of protection and administration on the National Forests (exclusive of emergency fire fighting, improvements, development, and research projects) is only $78,000. Allowance must be made, however, for a very severe fire season. It is quite logical, therefore, that on account of the losses during the past fiscal year of almost $5,000,000 that Col. Greeley should argue for a more intensive campaign of prevention. Such a severe loss as this in one fiscal year certainly justifies spending more money on prevention, especially when one considers that the damage is apt to be lasting, since "the land that was burned over the second time will now have to be artificially resown to secure a new timber growth."

" . . . The basic idea of forest management, namely, controlled use with a constant renewal and perpetuation of the resource," receives due emphasis because of the economic relation of the forest to local communities and local industries and because of the need of development along stable lines. During the next four years it is likely that an attempt may be made to break up certain conservative features of National Forest administration in order to secure more rapid local development at the cost of the future. It was therefore an excellent plan for Col. Greeley to emphasize the opportunity for pulp mill purchases in Alaska and to encourage the conservative use of forests under the National Service administration. There appears to be a chance for twelve or fifteen large paper mills in these Alaskan forests which, when established, should help to relieve the pulp shortage in the United States.

During the year 324 acres were sown and almost 7,000 acres replanted; the reforestation in Minnesota on National Forests which can be planted "cheaply and effectively" should certainly be increased.

The report reviews the use of the range and the need for further range classification. Probably during the next decade there will be an unexpected development in water power, partly on account of the high cost of coal.

The chance for the public to enjoy camping, shooting, and fishing in National Forests is a pleasing contrast to the conditions which exist in Europe where only the rich can enjoy these forms of recreation.

Perhaps, however, the Forest Service is going to an extreme when it makes the maximum charge for residence permits at $25 per annum. It appears to the reviewer that this maximum should probably be increased to $50 or $100, but this is a minor point compared with the great success of the use of the forests for recreation.

The increased road and trail improvement during the year is gratifying. But when it is realized that the Federal co-operation with the States in fire protection was only to the extent of $93,000, it is clear that Congress should provide additional funds for the coming year. The great financial achievement of the Forest Service seems to be in having spent $2,000,000 at the Madison Laboratories, thereby saving industry at least $30,000,000 annually. It is a pity that Congress is not more liberal in its appropriations for forest research since investigations had to be reduced 36 per cent below the preceding year owing to restricted appropriations. *If every Congressman would read this report, it is certain that he would be convinced that money appropriated for the Forest Service is money well invested.* But he would probably ask, "When will the National Forests be self-supporting?"

T. S. W., Jr.

Yellow Birch and Its Relation to the Adirondack Forest. By E. F. McCarthy and H. C. Belyea. Tech. Pub. No. 12, N. Y. State College of Forestry. 50 pp., 8 figs. 1920.

This is a very timely contribution to our knowledge of Adirondack hardwoods. Like faith, hope, and charity in the Scriptures, there remain beech, birch, and maple in our North Woods—"but the greatest of these is" birch.

The introduction explains that a complete study of the yellow birch was planned by the college and that the work was started by several departments. The publication under review is a part of this larger study and, after a fundamental discussion of the types and conditions found in the Adirondacks, presents comparative data to show the silvicultural relation of the birch to the other native species.

The types recognized and described are those almost universally agreed upon for the Adirondack region: Swamp, spruce flat, hardwood, and upper spruce slope. Swamp is "of small importance in a study of yellow birch . . . since birch does not enter into the forest as a merchantable tree in the true type." Tables showing the virgin

stand in this type include yellow birch "because the tree appears on the margin of the type and on knolls, or well-drained spots where the small size of the area prevents elimination from the type."

On spruce flat "birch exceeds in number all other hardwood species." In the hardwood type "the lower, moist hardwood land will have more birch than the better drained parts." On upper spruce slope "yellow birch is the most widely distributed and best developed hardwood tree. . . . It can thrive better than maple or beech on the thin soils, and can reproduce best of all hardwoods in the deep humus."

The authors then review the influence of logging on the forest and reach the following interesting conclusions. Where (1) the cutting was of softwoods to a diameter limit, the hard maple and beech exceed birch in the reproduction on the hardwood type because "the light cutting was not enough to open up the crowns to allow birch to succeed." This statement is supported by comparative data on the number of seedlings and trees less than 1.5 inches d.b.h. on hardwood land logged (*a*) to a 10-inch diameter limit and (*b*) clear cut. Per acre, sugar maple shows: (*a*) 3,779 trees, (*b*) 83 trees; beech shows (*a*) 1,036 trees, (*b*) 578 trees; yellow birch shows (*a*) 224 trees, (*b*) 2,530 trees.

Where (2) all merchantable softwoods are cut, the resulting forest on flats and hardwood lands will be "more largely hardwoods, but will not exclude softwood reproduction . . . there will be a large mortality due to windfall and exposure." Ten years after cutting the hardwood type shows beech 45 per cent of the stand, birch 22 per cent, maple 17 per cent, spruce 10 per cent, and hemlock 6 per cent.

Where (3) both hard and soft woods are cut clear (in the limited sense as carried on in the large logging operations) the results are: (*a*) numerical preponderance of hardwood reproduction, (*b*) dominant position of yellow birch in the stand, (*c*) the failure of hemlock reproduction, (*d*) the prevalence of fire cherry and absence of aspen, (*e*) the more rapid height growth of hardwood than of spruce seedlings.

An average acre of hardwood type cut clear 11 years previously, showed trees one-half inch and over, d.b.h., 1,874 birch, 1,413 sugar maple, 1,218 beech, 968 red maple, 552 fire cherry, 157 spruce, 105 black cherry, and a scattering of lesser species. The average diameters and heights of the reproduction were as follows: Birch, 0.8 inch d.b.h., 11.0 feet high; sugar maple, 0.7 inch d.b.h., 10.8 feet high; red maple, 0.9 inch d.b.h., 11.0 feet high; beech, 0.8 inch d.b.h., 10.1 feet high; black cherry, 1.0 inch d.b.h., 14.0 feet high.

The spruce, 1 to 10 feet high at the time of cutting, had made a total height growth of only 5.2 feet since then.

In the spruce flat type, cut clear 11 years ago, a 1-acre permanent sample plot was established under the plan approved by the New York Section of the Society of American Foresters (JOURNAL OF FORESTRY, XVI, 8, 922-927). Six excellent charts show the conditions on this area and support the following observations: The brush piles still prevent the reproduction of forest on the spots they cover. The crown cover is open and the ground is covered largely by raspberry bushes. Less than 8 per cent of the seedlings are softwoods because the "deep humus . . . dries severely on exposure to the sun (which) prevents tree seeds from germination and checks the growth of seedlings . . . most marked on burned lands, its effect appears on cut-over lands wherever the soil is exposed to direct sunlight. The . . . raspberry bushes . . . are not in foliage early enough to protect the germinating softwood seedlings."

Space does not permit of a similar detailed review of the remaining portions of the bulletin, although these are equally valuable. A discussion of planting on cut-over lands is much the same as Professor Belyea's paper read at the annual meeting of the Society of American Foresters in New York on December 20, 1920, and will be found printed in the February number of this volume of the JOURNAL.

Next is discussed the influence of burning on the forest. On an average acre of hardwood land burned 11 years ago and cut 5 years previous to that, there were the following trees 1 inch d.b.h. and over: 800 fire cherry, 234 aspen, 168 red maple, 145 yellow birch, 89 sugar maple, 85 black cherry, and a scattering of others.

The height and diameter growth of hardwood saplings is shown by means of a series of the excellent graphs for which Professor McCarthy has become noted. The trees are all plotted to 14 years of age and diagrams on the same scale are presented for comparison. In pole stands of yellow birch, measurements were made at Lake Ozonia and at Cranberry Lake, the former in a stand 60 years old showed the following representation of trees 1 inch d.b.h. and over, on an average acre: Yellow birch, 844; aspen, 92; spruce, 80; sugar maple, 73; hemlock, 57; beech, 45; total of all species, 1,223.

At 60 years the yellow birch had attained an average total height of 54 feet and a d.b.h. of 6.5 inches. In the 40-year-old stand at Cranberry Lake the results were comparable and warrant the conclusion

that "small burns surrounded by standing timber . . . reproduce readily to birch in addition to the aspen . . . a nurse crop under which the more tolerant hardwoods and softwoods enter."

The two last tables (XVIII and XIX) in the publication are, respectively, a volume table (by log lengths) of yellow birch, Scribner rule, and what is incorrectly headed a "yield table" for yellow birch, since it is not on an acre basis, but shows, by decades, the growth of the individual tree in d.b.h., in total height, in clear length, in merchantable length, and in board foot contents. In the table of contents this table is correctly described as "Growth of Yellow Birch in Virgin Stand." This is one of the few technical slips in the bulletin.

The "bibliography" which concludes the bulletin is not worthy the name, since it lists only Bulletins 26 and 30 of the old Division of Forestry. Much water has flowed over the dam since that time as the authors well know, having themselves contributed not a little to the literature on this subject. The omission of the U. S. D. A. Bul. 285, "The Northern Hardwoods," is particularly striking.

Taken in its entirety, this publication does more to clarify the silvicultural side of our intricate Adirondack hardwood problem than anything hitherto published. The authors have rendered a real service to their profession. A. B. R.

Vest-Amerikanske traeslag for Norges skogbruk. Thomas Stang. Kristiania, Norges. Pp. 25. 1920.

An English translation of Stang's interesting article on West-American tree species for growing in Norway has recently come to hand. While in America studying forestry the author traveled in the West and became interested in the possible economic use of a number of Pacific Coast species for use in Norway, particularly in its central and eastern parts. The climatological studies discussed in his paper were preliminary to securing seeds of at least six species from localities in the West that appeared to warrant their use in particular localities in Norway.

The researches of Engler, Zederbauer, Dengler, Ceislar, Kienitz, Hüffel, and others show that success in artificial regeneration depends very largely upon the origin of the seed. Engler goes so far as to state that the failures in Scotch pine in Switzerland have been due almost entirely to collecting seed in wrong localities. We are coming to appreciate that forest tree seed collected in other countries from where

sown fail to produce desirable stands when climatic and soil conditions are dissimilar. For many decades American tree seeds have been sown in Europe and seeds from European species have been used in this country. Failures have been far more frequent than successes.

The species selected by the author for introduction based upon geographical range, silvical characteristics, and meteorological data were as follows: Engelmann spruce, western yellow pine, lodgepole pine, Douglas fir, western red cedar, and black cottonwood. A study of climatological data from the Pacific Coast shows that the climate of British Columbia is more comparable to the climate of Norway than that from any part of the United States and the inference is drawn that Pacific Coast tree seeds for use in Norway should be collected there rather than in the States.

A comparison of climatological data from British Columbia and Norway show striking parallels. Based on differences in precipitation, British Columbia may be divided into three longitudinal belts, namely, the costal belt, the dry belt, and the interior wet belt. It is shown that Norway exhibits somewhat similar belts with comparable precipitation and temperatures. The annual precipitation over the costal belt in British Columbia varies from 40 to 120 inches, the greatest precipitation occurring on the western side of Vancouver Island and the outer coast and decreasing eastward toward the axis of the mountains. In Norway, the western slope of the mountains extending to the coast has an annual precipitation varying from about 35 to 100 inches. In the dry belt of British Columbia the annual precipitation is less than 20 inches. This condition is paralleled in Norway in the eastern part of Jotunheimen and Doore and in the northern part of the eastern valleys. The interior wet belt in British Columbia with an annual precipitation varying from 20 to 60 inches finds its counterpart in the mountains of eastern Norway.

As temperature differs with altitude and local conditions mean monthly temperatures were compared for selected localities in British Columbia with others in Norway. So also the latest killing frost in spring and the earliest in the autumn were compared so far as data were available. The distribution and silvical characteristics of the species considered for introduction into Norway are discussed in connection with climatological data from the two countries. Climatological comparisons were made between Mesnalien and Tonsaasen in Norway and Barkerville and Quesnelle Forks in British Columbia, the latter

stations being within the range of Engelmann spruce. The mean monthly temperature curves show that the temperature during the growing season at Quesnelle Forks is slightly warmer and the temperature at Barkerville slightly colder than at Tonaasen and Mesnalien. The extremes in temperature are slightly greater in British Columbia than in Norway, but as the length of the growing season is practically the same and the mean monthly temperatures are very similar the fact that the extremes are slightly greater in the two localities in British Columbia there is reasonable certainty that the Engelmann spruce will be frost hardy in the two localities in Norway.

The precipitation at Barkerville and Quesnelle Forks when compared with that at Tonaasen and Mesnalien show a striking similarity, both in annual amount and in its distribution over the year.

The writer's conclusion is that seeds of Engelmann spruce obtained on the mountain slopes between Quesnelle Forks and Barkerville or from other places in the same general locality are acceptable for use in Tonaasen and Mesnalien and in other localities in Norway with similar climate. It is believed that trees grown from seed collected at an elevation of 4,000 feet will be found frost hardy at or even above the present timber line in Norway. Although the quality of the wood of Engelmann spruce, its rapidity of growth and resistance to injury, are not superior to the Norway spruce, as it is hardly with a shorter growing season and is more wind-firm, it is worth trial in the high mountains of Norway, at or slightly above the present timber line where the native species is inferior.

In similar manner to the above the five additional species are discussed from the point of view of distribution, silvical characteristics, and climatological data.

It is believed from the data studied that seed of lodgepole pine from the higher altitudes in British Columbia is acceptable for use in the birch belt in Norway considerably above the present coniferous timber line.

Special consideration is given to western red cedar for introduction into the lowlands of eastern Norway. Due to its rapid growth, excellent natural reproduction, and the superior quality of the wood, it would if successful add materially to Norway's forest resources.

The earlier work of Smitt on the climate of the coast of Norway as compared with the northern Pacific Coast made it unnecessary for the author to repeat the work. Smitt found that the climate of the two

coasts is similar to the same extent as the climate of the interior regions discussed. Seed of Douglas fir were obtained by Smitt from Bella Coola, British Columbia, and from Portland, Oregon. The report from the Norwegian Vestlandits Experiment Station shows that the seedlings from the Bella Coola seed survived the first winter while those from Oregon seed did not. The author recommends seed of this species collected on the coast of British Columbia for use in the coast regions of Norway.

Climatological records appear to show that western yellow pine can be safely introduced into limited areas in the dry interior valleys of southern Norway (precipitation 18-20 inches). Seed, however, should be collected toward the northern limit of its range in British Columbia. It is shown that the climate of Nicola Lake near the northern limit of the range of this pine is very similar to that of Eidsvold, southern Norway.

The writer's conclusions are that in introducing exotic species of forest trees into Norway the following merit most careful consideration:

(*a*) Only such species should be introduced as are superior to the native species for particular purposes and for special reasons.

(*b*) The localities selected for the collection of the seed of each species introduced should be on the basis of climatological comparisons between the places where the seed is collected and the places where it is to be used.

The poor reputation that exotics have for seeding and planting in forestry undertaking and the financial loss that has resulted from their use can in many instances be charged to collecting the seed in wrong localities.

We cannot hope to modify a species perceptibly by forcing it to grow under a set of conditions different from that of its natural habitat. Before seeds are collected for use in foreign countries we must know how closely the site factors when the seed is collected conform with those where the seed it to be used. J. W. T.

Chemistry of Pulp and Paper Making. By Edwin Sutermeister. New York: John Wiley and Sons, Inc. 1920. Pp. 479.

Mr. Sutermeister, who is chief chemist of the S. D. Warren Company Paper Mills, has written a simple, straight-forward textbook on the

chemistry of pulp and paper making. Taken together with Witham's "Modern Pulp and Paper Making," it constitutes a most excellent source of authoritative information for all interested in this highly important forest product. Hitherto Cross and Bevan, and Clapperton, and other British authors commanded the field. Now the need for an American book, dealing with the American aspects of the pulp and paper industry, has been met. There remain to appear the series of technical textbooks which are being issued jointly by the Canadian Pulp and Paper Association and the American Paper and Pulp Association to make the tale complete.

Sutermeister presupposes that his readers have a fair knowledge of the elements of chemistry, but the book has been written so simply that any one connected with the pulp and paper industry can readily understand it.

The book divides into sixteen chapters and an appendix. The first chapter is a discussion of *cellulose* and is based on a careful review of the literature relating to the subject. Chapters 2 and 3 deal with the fibrous raw materials (especially wood) and with rags, esparto, straw, and bamboo. Strangely enough, the drawings of various wood elements (figs. 1, 2, and 3) are all based on non-American woods. Similar drawings might easily have been obtained for our native pulpwoods and would have been of far greater value. On the other hand, the photomicrographs, prepared by the Paper Section of the U. S. Bureau of Standards, are all of material used in America and, for the woods, include red spruce, white spruce, balsam fir, jack pine, hemlock, Douglas fir, aspen, yellow birch, beech, chestnut, tulip-tree, sweet gum, hard maple, silver maple, and black gum (plates 12-26). The author gives the range, qualities, and uses (for pulp) of these species. For jack pine he says: "It is not suitable for use in the sulphite process" (p. 59). Nevertheless, the Laurentide Co. (1920) used it up to 20 per cent with spruce in making newsprint!

Chapters 4, 5, 6, and 7 deal, respectively, with the soda process, the sulphate process, the sulphite process, and the mechanical process of making pulp, the last three named being confined to wood as a raw material. Each process is described concisely as to methods used and yields obtained.

Chapters 8, 9, 10, and 11 deal, respectively, with bleaching, sizing, loading and filling, and coloring.

Chapters 12, 13, 14, and 15 deal, respectively, with coated papers, with water and its importance in paper making, with the testing of wood pulps, and with paper testing.

The final chapter (16) is a brief presentation of printing and seems to round out the book since it shows the practical application of what has gone before. The appendix brings various tables, including one on physical constants.

In typography and general make-up the book is of the customary high standard of John Wiley & Sons' publications. A. B. R.

The Why and the How of Forestry in Louisiana. By R. D. Forbes, Superintendent of Forestry, Department of Conservation, Louisiana.

We are glad to have received this bulletin, issued by the Louisiana Department of Conservation, and to have a chance to review it, for we like it. And we like it mainly for its ability to deal with certain facts in such a way as to bring out both their meaning and their menace. It sounds a clear call to the citizens of Louisiana to wake up to, and cope with, the dangers of forest depletion.

In a swift word or two, Mr. Forbes deftly shows us, first, Louisiana as the early settlers received the region from the hands of Nature—a picture of boundless wealth held in the ample folds of an almost unbroken forest. Then follows the hand of the Destroyer, at work; and in such statements as "Already we have cut the forests from a territory about half the size of the whole State," we recognize with alarm the extent to which the green mantle of the past has already shrunk.

As a logical result of this calamity, the citizens of Louisiana are next faced with *present* forest conditions and their consequences. This is done, not through any mere generalizations, true, more or less, of most any region, but by means of direct, concrete statements, showing facts as narrowed down to their own State, and as affecting their own welfare; present conditions and their consequences as felt in Louisiana today. Results of forest depletion, both now and in the near future, are graphically shown stalking through the State in more than one ugly guise, called by name, and shown up as "Timber famine," "Shrinking taxes," "Deserted communities and fewer jobs." Listen, to the following:

"For example, 10 years from now, just about the time when the boys and girls now going to school are going to be building homes of

their own, for which they will need lumber and forest products of all kinds, the amount of pine lumber which we can cut each year will be between one-third and one-half of what it is now. Twenty years from now there will be very little indeed left of our virgin timber of any kind. The nearest virgin timber to Louisiana in any large quantities will then be 3,000 miles away (by rail) in Washington and Oregon."

What do you think the boys and girls, now going to school, are likely to say to that? And the boys and girls are undoubtedly entitled to their say.

Then, further on, under "Shrinking Taxes," the following is encountered:

"We are all proud of the progress which our State has been making in building new roads, fine schools, and other public improvements. Many of these improvements, particularly the good roads, have been made with borrowed money and the debts must be paid in future years. . . . Where is the money to come from to pay these debts and to meet the expenses of running our parishes, if we are constantly cutting away the forests upon which are paid the greater part of our taxes, and turning valuable land into nearly worthless wastes? Yet that is exactly what we are doing in many parts of this State."

Nor is that all of the indictment. The responsibility of the present for the future is further summed up in the following vivid picture:

"More than one-fourth of a million people in Louisiana depend for their daily bread on the lumbering industry and other industries dependent on the forests; probably 75 towns in Louisiana which are now thriving, busy places with good homes, schools and stores, are not likely to outlive the sawmills which have made them centers of population. Already there are deserted towns in Louisiana from this cause, and some day the whistle on the sawmill in these other towns is going to blow for the last time, because the last logs have been cut in the woods and the last boards have been sawed. Then the formerly busy town will shrink rapidly in size; there will be no more jobs, men will move away, and homes will be deserted; stores will close; the bank will shut its doors; and the school will steadily drop in attendance. The farmers in the neighborhood who used to bring in vegetables, grain, and meat to sell to the mill-folk, will no longer have a handy market, and will have to ship their produce to distant markets. . . . Expensive lumber, dwindling taxes, fewer jobs, and deserted villages are the price which we pay for the constant cutting of the forests without any thought for the future."

These are all home-thrusts, well directed. The conclusions to be drawn from them are convincing, and inescapable; and what is more,

they are of a nature to produce results. It is just this kind of graphic, definite presentation that is likely to catch the eye, so to speak, and thereby ensnare the mind. Under the spell of it, lethargy naturally gives place to interest; and interest, as we know well, is the lever required to overcome indifference.

With this much gained, Mr. Forbes next proceeds to make it plain that forestry is the remedy for forest depletion. He points with considerable pride to what the State is doing in the way of practical forestry; and, at the same time, with equal clearness, points out the obligation resting upon the citizens, one and all, to lift their full share of the load. The work of the State for the People, and, the resulting duty of the People to the State, are both handled to good purpose.

Then, as a final word, the great need for more wide-spread education on the subject, is stressed—education directed along such broad lines as to recognize not only the men and women of the day, but the rising generation, as well. In pressing this point, Mr. Forbes is urgently seconded by Commissioner M. L. Alexander of the State Conservation Commission, who, in a preface to the bulletin, assures us that it has been prepared with the schools particularly in mind.

Upon this subject of education along such lines, we have only to say that the wisdom of pursuing such a course is not to be doubted. It is essential for both generations, the present and the rising. And, speaking more especially in behalf of the latter, it seems altogether safe to add that, should the States, far and wide, wake up to the importance of such a move, and enter upon an intensive campaign of education in this direction, it would not be long before the country would be filled with what might be best termed "foresters-at-heart"—that is to say, the kind of men and women who, as the result of an intelligent grasp upon the subject, will no more tolerate a forest fire than a house afire; who will call for conservative lumbering, and *get it;* who will write effective forestry legislation upon the statute books, and see that it goes into operation; who will intuitively perceive the value of farm forestry, and will, likewise, have the vision to deal with the far-reaching problems involved in forest taxation. And that is the kind of citizens that is needed.

Louisiana's forest officers are altogether right in their position on this point, and we wish them every success in the campaign of education upon which they have entered.

J. S. P.

PERIODICAL LITERATURE

SOIL, WATER, AND CLIMATE

Distribution of Forest Types

G. A. Pearson, Director of the Fort Valley Experimental Station in Arizona, gives an excellent analysis of factors controlling the distribution of forest types. He describes the physical characteristics, including temperature, precipitation, wind and evaporation, and soil factors. The articles are well written, with complete tables and diagrams. He gives a summary of the results for the following types: Pinion-juniper, yellow pine, Douglas fir, Englemann spruce. Pearson concludes "that the upper altitudinal range of all tree species in this region is determined by low temperature, and the lower altitudinal range by deficient moisture." T. S. W., Jr.

Pearson, G. A. *Factors Controlling the Distribution of Forest Types.* Ecology, Vol. 1, Nos. 3 and 4, 1920.

MENSURATION, FINANCE, AND MANAGEMENT

New Formula for Selection Forest

S. H. Howard criticizes the present method of regulating growth in India which requires stock taking, a knowledge of the time for trees to pass from one diameter class into another, and a knowledge of the percentage of survivals and he discards Von Mantel's formula which requires measuring the whole growing stock, usually impractical in India.

Instead, he suggests the formula Yearly Yield $= \frac{V}{3/8\ R}$. Where V is volume of all trees in the forest over half the rotation age and over, and R the rotation. The only data required are rotation, stock taking of trees of half the rotation age and over, and the substitution of diameter for half the rotation age. In subsequent issues of the *Indian Forester* this formula is criticized because "no system can be a system which does not only perpetuate the forest but which does not also assure its progression towards a normal forest." Replying to this criticism, Howard states that nobody would use the Von Mantel formula if data were available for a better calculation. He cites an

example to show the answer secured by using the old Indian formula, the French method of 1883, and the $\frac{V}{3/8\ R}$ formula. From the example worked out it appears that the Indian formula (in the case sited) gives a yield of 23,234 square feet, the French method of 1883 22,303 square feet, while the Howard formula gives 18,094 square feet. Clearly the Howard formula is based on a rule-of-thumb method that doesn't require complete stock taking. It is open to the criticism that most formula methods are subject to. T. S. W., Jr.

Indian Forester, Aug., 1920, pp. 417-421; Dec., 1920, pp. 654-660; Jan., 1921, pp. 44-48.

Growth Data in British India

C. Y. Trevor gives the growth data for Deodar, Kail, Chir, spruce, and silver fir in three quality classes based on inch diameter classes. For those desiring to plant any of these exotics from British India fairly reliable information as to the height and diameter growth can be secured.

It appears that when Deodar is a 20-inch tree is it 90 years old and 76 to 106 feet in height; a 20-inch Kail pine (the Indian 5-needle "blue" pine) is 72 years old and 69 to 100 feet in height; while the 20-inch Chir pine is 95 years old and 69 to 96 feet in height. The spruce and silver fir (averaged together) reaches 20 inches in diameter 23 years old and is then 67 to 108 feet in height. T. S. W., Jr.

Indian Forester, Sept., 1920, pp. 339-451.

UTILIZATION, MARKET, AND TECHNOLOGY

Bamboo and Paper Pulp in British India

Owing to the demand for information on the use of bamboo for paper pulp in British India, R. S. Pearson reviews in detail the resources, location, and qualifications of this product for the successful manufacture of pulp. He states the minimum amount admissable for a "going" plant is 20,000 tons of air-dried pulp per annum, and that extraction shall not cost over $5 per ton for air-dried bamboo, f.o.b. mill. It thus appears that the raw material must have little or no local value and must be available in large quantities, easy to transport by water, and that the import

of chemicals, coal, etc., and the export of the finished product to a seaport be practicable. Preferably, the factory site should be on a river drainage from which the raw material is obtained, and have water connection with the seaport. Lime must be cheap, there must be a large supply of fresh water, cheap labor must be available, the locality must be reasonably healthy, and the life history of the local bamboo stands must be fully studied.

Pearson reviews the characteristics of a number of bamboo species, cost of production, and discusses in detail possible mill areas on the different forests in British India. The article is evidently prepared with a view to the commercial possibilities of developing this industry.

T. S. W., Jr.

Indian Forester, Nov., 1920, pp. 547-561; Dec., 1920, pp. 603-631.

Jarul Wood—British India

R. S. Pearson, Economist at the Forest Research Institute, Dehra Dun, contributes a monograph on Jarul Wood (*Lagerstroemia Flos Regina*, Retz). The monograph gives the general distribution, local distribution, natural and artificial reproduction, description of the tree, description and properties of the timber, uses (buildings, dugouts, huts, beams, planks, posts, interior woodwork, furniture, spokes, telegraph poles, gun stocks, turnery, etc.), method of working the forest, royalty and local rates, out-turn, cost of delivery, development of trade. It is quite evident that the monograph (which contains an excellent specimen of the finished wood as a frontispiece) is designed to advertise the species and to give a prospective purchaser an idea of its commercial possibilities.

T. S. W., Jr.

STATISTICS AND HISTORY

Forest of Haguenau

Huffel, former Director of the Nancy Forestry School, gives a very complete history of the famous Forest of Haguenau in ten chapters, two appendices, and three illustrations. He reviews the origin, area, and description of the property, attempts at improvement, local legislation and administration, organization and re-organization, working plans, and a critique of the German management of this forest after 1870. The book contains much data of value.

During the German administration, when the rule was clear cutting and planting, it is interesting to note the following windfalls and

snow losses: 1874, 10,000 cubic meters; 1876, 25,000; 1884, 10,000; 1886, 6,000; 1892, 6,000; 1902, 4,000; 1905, 20,000; 1906, 29,000 cubic meters.

Hueffel evidently doesn't agree with artificial regeneration following clear cutting on a forest where natural regeneration is perfectly practicable. He also feels that there has been a sacrifice of very large timber so valuable to local woodworking establishments. He feels that thinning in the dominant trees of the stands has been neglected.

By far the most interesting point brought out is that during the years 1912 and 1914 the net revenue was about $4 per acre and that the average soil and growing stock value was $300 per acre. For this period, the total net revenue was 679,200 francs per year, while the capital value of the forest and soil was about 50 million francs. This means that the financial returns were only 1.3 per cent on the investment, a return which is unquestionably less than most forests in France proper. It will be of interest to see how the French change the German methods of clear cutting and planting and whether the financial returns on the investment can be improved under the French administration.

T. S. W., Jr.

Huffel, G. *La Forêt Sainte de Haguenau.* Berger-Levrault, Paris. p. 162.

Wood and Pitch of the Ancients

That wood and such a forest product as pitch were important commodities in the ancient centers of power of insular Greece, Macedon, Asia Minor, and Egypt, especially during the period 315 to 166 B. C., is pointed out in this learned historical article. The dates of certain political events of historical significance are determined and checked by relating them to the price fluctuations of pitch during this period. Macedon, even from the fifth century B. C., had an interesting monopoly of these materials. The king granted licenses, often as marks of special favor, permitting the exportation of pitch and wood. For certain species special additional licenses also had to be obtained. The price of exported wood and pitch often fluctuated with the whim of the ruler, who might permit either free or restricted exportation, and also was influenced by the conditions surrounding defeats or victories in arms. Wood, of course, was of fundamental significance for the naval construction of the day and the balance of power in war was often considerably affected by

the forest resources of the country. Pitch from "Macedonian pine" was used as a coating for the sacred altars at Delos and also for the doors and other woodwork in the sanctuaries. Cargoes of pitch and timber were presented as gifts of high excellence to Rhodes after she had suffered from earthquake ravages. It is stated that the best pitch came from sunny lands which slope toward the north.

Terebinth, another resinous material, obtained in Syria, was exported to Egypt where it was used for embalming. Pitch was also obtained from southern Italy. ELOISE GERRY.

Glotz, Gustave. *L'Histoire de Délos d'après les Prix d'une Denrée.* Revue des Études Grecques. Tome xxix No. 133-134, Juillet-Septembre. 1916. Paris. Ernest Leroux, Éditeur, 28, Rue Bonaparte, vi^e^.

POLITICS, EDUCATION, AND LEGISLATION

Forest Policy in France

Raux, an assistant inspector in the French Forest Service, makes a strong plea for "coercive forestry" as contrasted with what he terms "liberal forestry." After showing how forest management is linked with economics, he argues for acts in the forest rather than official statements and bulletins.

He shows that it is necessary to stop the virtual deforestation of private land which has been going on. Instead of acquiring State forests at considerable expense, he believes in actually restraining private owners from devastating their forests and in encouraging private industry to reforest the ten million odd acres of land that could be reforested. He sites an interesting example at Neuchatel where to conserve valuable timber in private hands and *protect the water supply* every owner who desires to make a thinning, cleaning, or cutting, must have the marking authorized and executed by the local forest officer at the cost of the owner. Clear cutting on this land is rarely allowed, whereas without technical supervision private owners were really deforesting their land by pretending to get regeneration by clear cutting and planting.

Raux condemns the liberal forest policy of France promoted by the Law Audaffried of July 2, 1913, because owners would not willingly put their forests under the National Forest Administration for a minimum period of ten years; consequently the effect of the law would be nil. He argues for a coercive forest policy whereby private owners

would be made to submit the management of their forests to the State. He concludes "if we would diminish our wood and coal importation and not impoverish (from day to day) our timber which already covers an insufficient area, it is absolutely necessary, in order to avoid waste, to establish a serious future control of private forests whose area comprises two-thirds of our forest domain, and increase this domain by forestation composed chiefly of conifers because they alone can in a minimum of time repair the damage of war and furnish the wood which we are seeking outside France." Judging from this excellent article, Raux would vote for the Pinchot program rather than for the more moderate legislation which has been proposed. Clearly with higher prices and the chance for immense profits timber owners in France are cutting into their growing stock to a dangerous degree. Raux concludes that the sure way to enforce the proper practice of forestry is to have the marking done by trained foresters. T. S. W., Jr.

Reprint from Revue des E. et F., Nov. 1, Dec. 1, 1919, with the addition of "conclusions."

MISCELLANEOUS

Forest Research Institute in India.

In these days of expanded forest research in this country and in the establishment of forest research stations in eastern United States the very informing article in the February number of the Indian Forester on the new Forest Research Institute at Dehra Dun is of more than passing interest to American foresters.

Very little research work was done in India during the first half century of the existence of the forest department. The energies of the department were taken up in the selection, settlement, demarkation and protection of the large areas of government forests and in the introduction of working plans. The scientific work done was the result of the individual efforts of professional men who devoted their leisure to research. It was not until 1906 that a real commencement was made in organized research under Sir Eardley-Wilmot, the inspector of forests to the Government of India. Institute buildings completed in 1914, consisted of offices, laboratories and museums, also lecture rooms, workshops, and library.

The institute as originally organized included five main branches of research, namely, *Silviculture*, *Forest Botany*, *Forest Economic Products*, *Zoology*, and *Chemistry*; each branch being in charge of a research

officer. In addition to these permanent officers, specialists are attached to the Institute, temporarily, when necessary to carry out investigations in subjects of special current interest.

In India there appears to be a unanimity of opinion as to the necessity for a central institution to deal with the more strictly scientific portions of research and for the general guidance and co-ordination of investigation. Moreover, this central institution embodies research in each of the five divisions mentioned above. The Indian system is in the judgment of the reviewer, radically different from the system that has developed in this country, in that here there is no central station where research is actually carried on but centers in a number of stations widely separated. The office of research in Washington has no counterpart in the Indian system.

In the expansion of research in India now under way the present number of main divisions of research will not be increased, but each will be subdivided into a number of divisions, manned by experts under the general control of the head of each branch. Although the heads of each division and important branches will be Imperial forest officers the assistants will be recruited from the Imperial service and from native foresters trained at Dehra Dun.

It is proposed to strengthen the *Silvicultural branch* by adding two assistants from the Imperial service, making five in all.

The purpose is to divide the *Botanical branch* into three sections dealing with Systematic Botany, Ecology, and Mycology, each under an officer of Imperial status; also to increase the native assistants in this branch. The *Zoological branch* will be extended to deal with the main problems of forest zoology in various parts of India. Where heretofore there has been one forest zoologist, and two native assistants it is proposed to employ a systematic zoologist and four regional zoologists to conduct researches in different parts of India.

At present the economic branch is in charge of a forest economist aided by an assistant, both Imperial officers. To this branch will be added a wood technologist and an expert in minor forest products, both to be recruited from the Imperial staff. Various exports will continue to be temporarily employed in this branch to conduct investigations in such subjects as pulp resources and tannin. The chemical branch will be divided into sections according to the main lines under which investigators are to proceed. A forest chemist will be in general charge of the branch and biological and distillation chemists will be added.

The changes as proposed involve the increase of the Imperial Forest officers in the Institute from 5 to 11 and possibly later to 15. Certain officers such as the chemists, mycologist, pulp and tan experts will not be forest officers.

This extensive expansion of the work of the Institute will of necessity allow for a large extension in buildings and equipment. Although the present quarters at Dehra Dun will be retained a site of about 1,300 acres has been selected some four miles from Dehra Dun with a view of providing in addition of the requirements of the main buildings, workshops, and residences ample space for the necessary field work and for future expansion, which it is felt certain will take place.

American foresters should note the outlay for this greater Indian Forest Research Institute. It should give us heart to stand firm for more generous financial support for forest research in this country. The total outlay proposed for use at Dehra Dun for land, buildings, workshops, laboratory equipment and improvements is approximately $10,-193,000.00. This does not take into account the annual cost of maintenance and the salaries of a large personnel. The Indian Forest administration does not consider the amount by any means excessive, and believes that it will be money well spent in expediting the development of India's vast forest resources.

There is no inexpensive way to make forestry a vital part of our economic life. We must spend today for the safety of our future. Money spent today in forest research, in forest protection, in conservative lumbering and in reforestation is money invested. J. W. T.

The new Forest Research Institute at Dehra Dun. The Indian Forester, Vol. XLVII, pp. 49-59. 1921.

NOTES

Olympic Peninsula Visited by a Disastrous Cyclone

A terrific cyclone swept the forests of the Olympic Peninsula in the State of Washington on January 29. The tornado blew down timber estimated at five to eight billion board feet, in a strip 75 miles long and 30 miles wide; one billion board feet of which is within the Olympic National Forest. If the loss is as great as announced, and latest reports tend to increase rather than to diminish the extent of the catastrophe, this is the greatest disaster ever recorded in the annals of forestry or lumbering. A wind velocity of 132 miles per hour was recorded at the North Head Station of the Weather Bureau, near the mouth of the Columbia River, which was partly destroyed by the storm. The observer at this station estimates that after his instruments were wrecked the wind increased in strength to 150 miles per hour. The highest wind velocity ever recorded previous to this date on the Pacific Coast, was 144 miles per hour at the Port Mendocino Station in California in 1886.

The windthrown timber, according to the reports, lies in a tangled mass over an area of 2,250 square miles, is largely western hemlock and spruce, both of which are subject to rapid decay. Transportation is lacking for much of this region, and it is doubtful if any considerable proportion of the timber can be salvaged unless prompt action is taken. The stand was exceedingly heavy. Where the full force of the wind was felt practically every tree was thrown down, and all roads, trails, and telephone lines were completely obliterated. Much of this destruction is on land owned by private individuals and large timber companies.

If fire should ever gain headway in this devastated area, the most stupendous conflagration ever known in this country would result. The topography is very broken and the blow-downs are in part at least known to be "spotty," with much fine timber uninjured. Fire would not only destroy all these islands of timber but would seriously endanger a vast surrounding stand. Fifteen billion feet is exposed in the adjoining part of the Olympic Forest, besides large amounts on State and private lands. The destruction would be likely to exceed even that of 1910, the most appalling fire season ever encountered by the Forest Service, when over four million acres of National Forest land were

burned over in the west, and 6½ billion board feet of timber, valued at nearly 15 million dollars, was lost.

The Secretary of Agriculture has requested the Secretary of the Navy to detail hydroplanes for an air survey of the storm-swept region in order that the amount of damage may be determined, since it is impossible to traverse the uprooted forests on the ground. A request has also been made to the Secretary of War that the railroad constructed by the Spruce Production Corporation, extending from Port Angeles to Lake Pleasant on the Olympic Peninsula, be equipped with rolling stock and operated at its maximum capacity. This railroad is the one important line of communication into the devastated area, and will afford a means of salvaging a considerable amount of the down timber.

The Secretary of Agriculture has transmitted to the Secretary of the Treasury an estimate to be submitted to Congress for an emergency appropriation of $100,000 to enable the Department to employ patrolmen to guard the storm area against fire, to repair and construct roads, trails, telephone lines and other means of communication, and to salvage Government timber. Governor Louis F. Hart of Washington, it is reported, will also ask the State Legislature for an emergency appropriation of $100,000 to open up the country and co-operate with private owners and the Federal Government in intensive fire protection.

Grazing and Fire Control

It is the unanimous opinion of the Investigative Committee of the Pacific Northwest that properly regulated grazing is a large, if not the largest, single controllable factor which is operating to reduce the fire hazard.

Comparison between the ungrazed area in the Fort Rock Ranger District on the Deschutes and the contiguous grazed Silver Lake Ranger District on the Fremont is striking. On the former area the estimated fire damage and suppression costs for the last seven years total over a third of a million dollars, while on the latter it is estimated to be less than $4,000 for the same period. Timber cover, topography and climate are very similar on the two areas, but the Fort Rock District is unwatered, hence ungrazed. Here water development for range stock is the answer.

The Committee feels that there are a great many other areas of grazing land in the District, most of them relatively small, which are ungrazed or lightly grazed, and on which fire hazard could be very materially reduced by grazing. Even in approximately fully grazed areas there are patches where because of inaccessibility, lack of water, lack of salting, insufficient administration, or other cause grazing use is incomplete or lacking.

It is therefore the urgent recommendation of this Committee that the offices of Grazing and Operation co-operate actively and aggressively in extending grazing use as widely as possible, not simply with the idea of increasing carrying capacity, *but for the specific purpose of reducing fire hazard.* This may be accomplished mainly by increased administration in the field, and also by developing water, by opening up inaccessible areas, etc.

Also, it is recommended that where because of inaccessibility no grazing is possible under existing regulations, that consideration be given to the advisability of granting free grazing use of such areas for a period of years sufficient to justify users in opening them up; also since the Douglas fir region west of the Cascades includes the largest ungrazed areas in the District with high fire hazards, it is suggested that special consideration be given to the early expansion of grazing to this region.

Meeting of the New England Section

The New England Section held its winter meeting at the State House, Boston, Saturday, March 12. Twenty-one members and two guests were present. Professor Hawley, for the Committee on Research, presented an exhaustive report on the problem of dividing New England into forest regions and types, while Professor Chapman reported on the problem of applying intensive yield studies to extensive forest surveys.

At the afternoon session there was a discussion on the relation of professional foresters to the American Forestry Association, on which the general opinion seemed to be that the foresters should stick to the Association and help clean house from the inside.

Professor R. T. Fisher, of the Harvard Forest School, was elected chairman for the ensuing year, and H. O. Cook, Chief Forester of the Massachusetts Conservation Department, re-elected secretary.

The Yellowstone Elk Situation

In the New York *Evening Post* of February 5 there appeared an article on the elk situation by Emerson Hough in which was a scurrilous attack on the Forest Service and its officers. The following letter to the Editor of the *Evening Post* by former Forester H. S. Graves was written in answer to Mr. Hough:

"In your issue of Saturday, February 5, you published a contribution from Mr. Emerson Hough regarding the Yellowstone elk situation containing implications so grossly unjust to the Forest Service that they should not be permitted to stand unchallenged.

"Mr. Hough bolsters up his position by imputing motives. With the main issues involved I shall not now concern myself. Mr. Hough has a right to form and express his own opinions about them. But against his atrocious impeachment of the whole-souled loyalty and devotion with which the men in the Forest Service serve the public interest, often at large pecuniary sacrifice, I register most emphatic protest.

"'Friends of the wild game of America,' says Mr. Hough, 'get no pay. All they make is the enmity of men on Government payrolls who have jobs to defend and records to explain. There are some other men who have no jobs to defend, but only a country to defend the best they know how.'

"Will Mr. Hough say that he has received no pay for his articles regarding the elk which have been published in the various magazines at different times? And by what right does he arrogate to himself and those who agree with him a monopoly of patriotism?

"'The spreading of the truth,' he says, 'is the only thing which really can help the remnants of the Yellowstone Park herd.' True. Is he then rendering them a service, or the contrary, when he adds such a sentence as this?

"'It is a grievous situation when any citizen comes to feel that he and his country have been betrayed by that country's own friends, robbed by its own servants, and sold out by its own hired men.'

"These are 'wild and whirling words.' No man has a right to use them causelessly without rebuke. Abuse of public officials is as cheap as it is censurable; for those unjustifiably assailed are not in position to reply without restraint, while the effect is to impair their usefulness by undermining the confidence of the public in them.

"I have no job to defend, and can speak certainly with an authority equal to Mr. Hough's as to the spirit in which the men of the Forest Service work. As their chief for ten years, I am able to say with some confidence that they are as far from being job holders as it is possible to conceive. They are doing a work of immense difficulty, for far less pay than they are worth and could get if they chose to seek it,

in a spirit of loyalty and with ideals of public service which I believe can nowhere be surpassed. Neither Mr. Hough nor Mr. Sheppard could go before western audiences, where the work of the Forest Service is better known than in the East, and say the things they have said in the columns of the New York *Evening Post* without calling forth resentful challenge."

The appreciation of the Quebec Government of the necessity for the practice of forestry on its non-agricultural lands, and of the need for thoroughly trained foresters to make its programme effective, has recently been further evidenced. Four of the employees of the Provincial Forest Service have been sent to Europe by the Provincial Government, to spend a period of six months in making advanced studies of forestry practice and forest utilization in France, Belgium, Switzerland, and Germany. One of the men will extend his studies to cover a period in Sweden. Among the lines of investigation to which particular attention will be paid by these men will be methods of lumbering, saw-milling, silvicultural practice, reforestation, aerial photography, forest research, wood technology and wood utilization, including the development of markets for hardwood species through small wood-using industries.

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// JOURNAL OF FORESTRY

Vol. XIX MAY, 1921 No. 5

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

HAS THE AMERICAN FORESTRY ASSOCIATION LOST ITS FORMER USEFULNESS?

REFLECTIONS OF A LIFE DIRECTOR

By H. H. Chapman

PART VI—THE GROWTH OF AUTOCRACY

The development of a centralized oligarchic autocracy out of what was previously a democratic and representative form of government for the American Forestry Association was not the result of neglect or indifference on the part of the members of the board, but resulted from a long-continued, intentional policy on the part of three men, the Secretary, the President, and the Chairman of the Finance Committee, supported or at least not actively opposed by others of the active Board who consented to and tolerated these successive developments because of the financial benefits they were supposed to bring to the Association. This left a minority of active board members in opposition to these tendencies. Although Mr. Sterling had opposed Dr. Drinker's policy of neutrality toward National Forests, he did not oppose this tendency toward centralization at any time and even assisted in it. That the result now accomplished was foreseen is shown by the following letter:

February 5, 1916.

Mr. Charles Lathrop Pack,
Lakewood, N. J.

Dear Mr. Pack:

I am preparing a digest of the finances of the Association which I expect to send you in the near future.

I wish to call your attention to a tendency in the management of the Association which, I think, must be overcome. Mr. Quincy and Mr. Ridsdale believe that the affairs of the Association should be placed

in an executive committee of about three men, with a dummy board of directors. I think they conscientiously believe that in this way the business of the Association will be performed with neatness and dispatch, friction in meetings and long-winded discussion of policy avoided, and the maximum of efficiency secured. I am sorry to take issue with this point of view but experience has led me to believe that "in a multitude of counsellors there is wisdom."

As illustration of the concrete working of this definite policy, the enclosed contract of Mr. Ridsdale was railroaded through the board last January without their being furnished copies of it and without its being perused. They were simply told by Mr. Quincy that he had prepared the contract and it was satisfactory. On being questioned he stated verbally a few of the details. I will show in the summary how this contract has worked and what it threatens to do to the Association finances.

Next the project for enlarging the magazine was shoved through the board by letter ballot. This may have been a good move. That is not the point; there was no consideration of the matter by the board.

The policy of withholding the auditor's report and the details of the financial operations for the last year which were available and should have been presented at the annual meeting is a part of the general plan that the less the board knows about the detailed working of the operations the more efficient will the operations be.

The policy formerly inaugurated, of having a quarterly board meeting in New York has been discontinued and the meetings have been held infrequently, and staged, not in New York where they could have been better attended, but in places far distant which prevented the attendance of certain directors, and in connection with meetings which interfered seriously, on several occasions, with the work they had to do.

I flatly disagree with the whole policy of executive secrecy apparently favored by Mr. Quincy. Mr. Ridsdale has definitely proposed to me that the executive committee should be reduced which would mean the elimination, probably, of all but Messrs. Quincy, Lyman, and yourself, or possibly, Dr. Drinker. (Note.—This action was not taken, but, as shown in Part III, was carried out in principle by the unauthorized assumption, on the part of the Finance Committee, of all authority over the terms of the Secretary's employment.—H. H. C.)

The matter will come up in the near future in this concrete form that Mr. Quincy will wish to call a meeting of the executive committee instead of the meeting of the board and dispose of the financial policy for the year in this committee. Those members of the board who attended the Boston meeting had a right to hear something about the finances. The only safety for the Association at present lies in bringing the entire board in on this matter. We will then get some men like Gov. Bass, Jenks, Ames, and possibly others, who will have a voice in

determining whether or not matters of vital importance to the Association shall be considered before being passed.

I am not an obstructionist. I have permitted the bond issue to go through and did not oppose the new contract and have in every way endeavored to hold up the hands of the financial committee and the secretary. In fact, I believe that the contest with Dr. Drinker to establish firmly the policy of the Association was more important in securing and retaining membership than all the financial measures taken so far. I am doubtful, however, whether I can take the brunt of forcing a thorough and proper consideration, or rather re-consideration, of the vital question of the bond issue and the contract without creating in Mr. Quincy's mind the impression that I am deliberately hostile to him because I am opposing his pet policies.

I should prefer that there be some initiative in the board of directors who handle these vital questions other than that which I have been forced to give to it. After calling the attention of the board to the present condition I am strongly inclined to let it go at that.

This letter is to urge upon you that, if possible, you secure a meeting of the board in place of the executive committee.

If the executive committee is permitted to dispose of the financial policy for the year, this will mean that Mr. Quincy, Dr. Drinker and Mr. Lyman will have a preponderating voice in the matter and that the opinions of the board as a whole will not receive proportional consideration.

Sincerely yours,

H. H. CHAPMAN.

On February 16 the following letter was written:

February 16, 1916.

MR. CHARLES LATHROP PACK,
Lakewood, N. J.

DEAR MR. PACK:

The specific criticisms which I have to make regarding the present financial situation is that matters of the utmost importance are permitted to be adopted without a full understanding on the board, and therefore are acted upon in a perfunctory way. I am positive, for instance, that the present contract with Mr. Ridsdale was not understood by the majority of the board members, and I am equally sure that the effect of transferring the commissions from a net to a gross basis and increasing the cost of the magazine was not grasped at all, possibly even by Mr. Quincy and those responsible for securing this action. I think that the terms of Mr. Ridsdale's contract were a mistake. The thing I regret the most is that I have been waiting patiently for the production of a net operating surplus which could be used for necessary and vital work and propaganda. The present

financial policy has caused this prospect to disappear so utterly that I now see no use in expecting it for ten years, and with it goes the hope that this work can be done by the Association in the way I had in mind. The other great criticism which I have had is practically removed by the final adoption of the plank defining the policy on national forestry. It is specifically that we can not hold our members or even hope to survive at all on the mere basis of printing a good magazine. The life blood of the Association is the principles for which it stands, the cause for which it is working. If this is not abundantly evident in the magazine, the members will drop out at such a rapid rate that our efforts to maintain our membership will absorb not only our surplus, but will cause an annual deficit. Please note this point particularly in my analysis. I feel like congratulating Mr. Quincy on his unselfish intentions, and Mr. Ridsdale upon the truly wonderful progress which the magazine has made, but neither Mr. Quincy or Mr. Ridsdale working alone, or permitted to work entirely on their own lines, will make a financial success of this Association. That is why I shall continue to strive for a true and full co-operation of a large circle of board members, and for the adoption, not only of a different and more aggressive policy for the magazine, but for more thoughtful consideration of financial measures previous to their adoption.

Most sincerely,

H. H. Chapman,
Professor of Forest Management.

The rapid decay of the authority and functions of the board which began in 1917 and culminated on February 25, 1921, was attributed by the President to the war, which served as a reason for omitting even the annual business meeting in 1919, after the 1918 meeting had not produced a quorum. But in 1920 the old custom of a big public meeting with discussions of forestry topics was not revived—instead, it was planned to hold only a routine business meeting in New York for the election of officers, the results of which meeting have been described. Again in 1921 at Washington the meeting was purely routine in character. At both of these meetings a great many persons appeared and voted for the President's ticket and program, who by no stretch of the imagination could be regarded as members who had joined the Association because of their interest in forestry. At the New York meeting there were numbers of young men who voted without removing their overcoats and promptly returned to their various occupations. It has been mentioned before that practically none of those who voted for the President's slate on this occasion

remained to hear the result or to attend to the business of passing the by-laws, while practically all of the opposition did so remain for three to four hours until the vote was announced.

At the Washington meeting, on February 25, 157 people appeared at the routine meeting, a very large proportion of them women, and many of so youthful an appearance that a reporter present remarked that it was a surprise to him to note that most of the members of the American Forestry Association were girls of high-school age. One of these young ladies was overheard in the elevator to remark to her companions, "Well, I don't know what all this is about, but Mr. Ridsdale wanted us to come over and vote, so we'll do as he says."

After the first vote of 157 to 15 in favor of the Directors' slate, about 25 persons left the hall, and there was a marked impatience among the rest to have it over with, and constant defections, so that on two or three occasions Mr. Pack loudly beseeched those who were escaping to remain just a little while longer as it would be soon over. It took a three-fourths vote to pass the by-laws, and with the experience of the preceding year in his mind, his anxiety was of course justified. But this atmosphere was not conducive to a calm and impartial discussion of these by-laws. Each of these voters signed a card at the door. No question has ever been raised by the members who voted in opposition as to the membership status of those in attendance, though in the close vote at New York the year before, the Secretary carefully preserved and attempted to check the status of the opposition voters, with the result previously mentioned in these columns.

The Secretary in his statement, issued on March 1, 1921, says, "Members are now (since the adoption of the new by-laws) entitled to vote by mail or in person (for eight out of fifteen directors, nominated by the board). This permits all to have a direct voice in the affairs of the Association, a much more democratic arrangement than that previously in effect, of allowing only those present at the annual meetings to vote." One of the delegates who traveled from Massachusetts to Washington to protest against the new by-laws expressed it differently but effectively, "What got my goat was that my vote that I came clear down to cast was offset by a young woman not over sixteen years old who was chewing gum."

This belated recognition of the merits of a reform in the election system, which had been prepared by Mr. Chapman at a previous board meeting, was not put into effect in passing upon whether these seven directors should hold office for life. This was determined by the 157 members present, and the plea of the delegates, that just such a mail vote on this issue should be taken was answered by Mr. Pack by the argument that it would cost $700 and the Association didn't have the money. The amendment to submit the by-laws by mail was defeated, 95 to 25. On March 1 the $700 estimated as the cost of this referendum by Mr. Pack, was apparently available and was spent in mailing to the members Mr. Ridsdale's circular praising the action taken at this meeting and extolling the democratic system of voting installed. This was followed by a second circular of similar character.

It may be true that the average uninformed members of this Association, having the average faith in the good intentions of persons in general, will accept this statement on its face value. The statement follows:

WASHINGTON, D. C., *March 1, 1921.*

TO MEMBERS OF THE AMERICAN FORESTRY ASSOCIATION:

Rapid development in the ability of the American Forestry Association to further promote the cause of forestry is assured by important action taken at the Annual Meeting of the Association on February 25. This was the adoption of amendments to the by-laws which remove the danger of the Association ever passing under the control of special interests, a condition threatened on several occasions, and which assure for all time its policy of truly representing and creating public opinion.

The amendments make seven of the directors—including President Charles Lathrop Pack—permanent directors. All these men have been directors for the past ten years or more. They represent forestry, conservation, lumber, paper manufacturing, banking, general business, and education—interests so diversified that these men are particularly representative of the general public. The other eight directors will be elected by the members who are now entitled to vote by mail or in person. This permits all to have a direct voice in the affairs of the Association, a much more democratic arrangement than that previously in effect, of allowing only those present at the annual meetings to vote. Rarely did more than 150 to 175 attend these meetings. This is about one per cent of the membership.

Adoption of these provisions assuring a continued public service and public-spirited policy also permits much better financial support of

the Association than in the past. Certainly that the Association is removed from danger of control by special interests is an assurance to those who desire to aid in its work through substantial financial support that their money is contributing directly to the public good. This condition having been met, the Association will now proceed in its endeavor to secure a substantial endowment for educational work. It has already been assured funds for a national publicity campaign for forestry and for many improvements in its magazine and other publications. It is also to acquire a fine, commodious building on Sixteenth Street, Washington, D. C., as a permanent home, a gift to the Association from President Charles Lathrop Pack.

The Association is therefore now in a position to do more to promote forestry than ever before. It will continue unhampered, its policy of truly representing the public. It will further its educational work to the limit of its resources. It will strive to greatly increase its membership, to extend its influence, to secure greater prestige, and to advance the whole cause of forestry in every way its capacity permits.

P. S. Ridsdale,
Executive Secretary.

The fundamental objections to an autocratic board are two, first, one man's judgment is never as good on matters of policy as that of several, and serious errors are possible; second, an irresponsible autocratic form of government is apt to produce abuses and selfishness, to the injury of the Association. Such results had already manifested themselves in a striking manner in 1919-20. It was the original policy of this board to exercise supervision over the contents of the magazine, with special reference to policy, for which purpose an educational advisory board was constituted composed of Ernest A. Sterling, S. T. Dana, S. N. Spring, F. S. Underhill, John E. Rhodes, and H. H. Chapman. This board was also intended to visé articles as to the accuracy of their contents to avoid the appearance of misleading statements, since the magazine was widely read and quoted. The Secretary accepted this board in principle, but after a brief space, ceased to consider it. Articles were never submitted for its inspection nor criticisms solicited. The names of the Advisory Board were printed in the magazine until in August, 1917, they were dropped and the Advisory Board although never formally discontinued by the directors ceased to have even a nominal existence. At no time had the members of this board neglected their duties. They were simply ignored. The only method of functioning was to write to the Editor, criticising some article or statement *after it had appeared in the magazine.*

During the summer of 1919 after the criticisms of the magazine began to appear Mr. Ridsdale began running a larger number of articles on forestry. In August there appeared, without warning, an article by Joseph A. Kitts, entitled "Forest Destruction Prevented by Control of Surface Fires," which had previously appeared in other publications, and which was a defense of the theory known as "light burning," which has given endless trouble in California, and should under no circumstances have appeared without editorial comment or a reply. The Secretary published it for its news value. In September following, another article was published, again without comment or a chance to reply, which proved to be a skillful attack upon the very foundations of economic forestry.

The indignation which these publications aroused led the Secretary to propose to Mr. Pack a plan by which the difficulty of satisfying the "foresters" could be solved and at the same time not clutter up *American Forestry* with forestry articles. Without consulting the Board of Directors, the plan was launched of getting out two editions of *American Forestry*, one, containing articles on forestry, to be sent to foresters only, the other, or popular edition, to go to the remaining members and to be devoted largely to popular articles on animals, birds and flowers, "such as the public are interested in." Two numbers of this foresters' edition were actually issued and contained several articles *written for the public by foresters* The plan, already in effect, was told to the board at its next meeting but no approval was asked, as Mr. Pack was paying for it.

Since the conception of foresters was that the magazine was intended to convey forestry to the public rather than to foresters, and that the articles contributed by them were for this purpose, and since they had their own publication in the JOURNAL OF FORESTRY, this plan did not receive their approval but the contrary, and much of Mr. Pack's later rancor at foresters as a class may be traced to this rejection of his philanthropic offer to provide them with an edition of *American Forestry* of their own. Had the board or any informed member thereof been consulted in this venture, its inadvisability would have been pointed out at once.

PART VII—THE FAILURE OF THE ASSOCIATION TO FIGHT FOR VITAL ISSUES

Financial independence carries with it independence of policy. Financial dependence entails loss of this independence, and subservi-

ence to those whose funds support the Association. Better for the American Forestry Association if it remained poor and feeble, but free to defend the public welfare, than to be rich, prosperous, and endowed with buildings and invested funds, and speak only when spoken to. A certain class of philanthropists are incurably afflicted with the malady whose symptoms are manifested in a belief that money purchases control of public sentiment and of the means for its expression. This was first manifested in the American Forestry Association in connection with the bond issue. Dr. Henry S. Drinker procured from his friends the sum of $7,500 which was invested in the Association bonds, paid them 6 per cent interest, and was finally returned to them in full. But on the strength of this financial assistance Dr. Drinker stated to the board in January, 1916, of which Directors Greeley and Jenks are witnesses, that had he known that the Association would take the position which it did with reference to the support of the National Forests, this money would not have been forthcoming.

Mr. Pack's attitude in assuming control was that any measure whose expense he defrayed was to be adopted on that basis alone, without the necessity of sanction by the board. Hence the forester's edition. But the final test of this principle came in the proposal to convert the Association into an autocracy. There were two arguments proposed to justify this: One was that it was necessary to prevent any group of members from capturing the Association by a raid on the meeting, which could have been met by adopting the system of letter ballots, properly safeguarded, that was in fact put into effect to apply to future elections of eight directors, and was therefore not a valid argument. The second, and the one which secured the consent of the remaining members of the board with two exceptions was that the Association was running behind and that a large sum of money would be given the Association on the one condition that its control should be placed in strong hands, safe from any possible change or overturn which might result in the diversion of these funds *to purposes inimical to the desires of the donors*, or in their misuse or waste—sound arguments when applied to a private business corporation, but whose sinister possibilities should be sufficiently evident as touching the American Forestry Association in the light of the rapidly increasing popular agitation for thorough-going measures of securing effectual management of forest lands regardless of ownership. Since this bargain was

carried out on February 25, it is for the public to judge whether this Association and its utterances still represent their best interests.

That the American Forestry Association has already failed to measure up to its responsibilities in defending public interests is the conviction of an overwhelming majority of the leaders of public thought and effort in forestry. Due to its failure, to the resentment of its officers at the criticisms which this failure induced, and their determination not to brook any interference with its management or policies, the Association now finds itself in active opposition to professional foresters as a class, whose training in economics and experience in public service have enabled them to sift the wheat from the chaff and detect the difference between genuine effort at forest reform and substitutes labelled "just as good."

It is true that the Association has from time to time engaged in campaigns to secure needed legislation. It is equally true that such efforts have seldom been successful or effective unless they were entrusted to and conducted by trained foresters acting temporarily as agents of the Association. One of the greatest fields of possible activity of the Association is that of the proper organization of State forestry.

When Mr. Ridsdale was challenged in the board meeting on February 25, 1921, he cited three instances of such participation. One, that in Kentucky, failed. A second, Virginia, occurred in 1916 and was brought to a successful issue by S. B. Detwiler, a forester. For the third, the Secretary went back to Minnesota in 1916, and then remembered that this writer had handled this case on the ground, devoting two months to it, and succeeding in preventing the destruction of the State Forestry Department. At the present time another and equally dangerous attack is being launched on this department, but Mr. Ridsdale did not publish an article on the subject submitted to him for the March number. The failure to participate in Texas has been noted. The Vermont fight was lost with no effective assistance rendered. The Association in its present condition is practically impotent to conduct such work effectively.

In national affairs the Association has been equally futile. It participated in an active manner in securing appropriations for experiment stations in the East and has appeared at hearings and published some literature in support of the appropriations for the Weeks law.

But the really big controversial issues such as National Parks have been scrupulously steered clear of. Now, after five years, when the public through other agencies has awakened to the perils confronting the National Parks, and are united on a program, the Association may and probably will join the procession. This issue was thoroughly explained to the President on January 15, 1917, and has not changed since then.

The tremendous issue involved in protecting Alaskan resources from ruin at the hands of private exploiters, involving as it were the very basic principles of conservation, was fully explained to the officers of the Association some five years ago, but no effort has been made to handle the subject and it will be fought out without the aid of the American Forestry Association, since, as Dr. Drinker states, it is controversial in character and this Association must take no side in a controversy as to whether the public or private interests shall prevail.

The fight to establish a quarantine against imported plant diseases, which have wiped out the chestnut and threatened the white pine with destruction, was put squarely up to the Association, which evaded the issue on the grounds that its officers did not wish to offend the officials of the Department of Agriculture. The quarantine was secured without their aid. Discussions of the Snell Bill and other proposed legislation by the Board of Directors revealed a state of vacillation and uncertainty as to this legislation, but after practically all the interests in the country had lined up behind it except those who favored much more drastic regulation, the Association was induced to climb aboard and is now advocating this bill. Leadership on forest policy or legislation can not longer be expected from the American Forestry Association under the form or organization adopted or the personnel of its governing body.

PART VIII—THE FORESTERS AND THE AMERICAN FORESTRY ASSOCIATION.

The most astonishing development of this entire situation is the attitude taken by President Pack and Secretary Ridsdale toward the body of men who have entered the profession of forestry and have since its first beginnings in this country devoted themselves unselfishly and wholeheartedly to public service. Yet this attitude is recognized as a measure of self-protection, growing directly out of the fact that such efforts as have been put forth to oppose the dangerous tendencies

which began to show themselves, were due to the perception by foresters of these conditions, and a sense of public duty, which caused these men to take a stand against conditions threatening to undermine the Association or to destroy its independence.

The President and Secretary on several occasions have stated publicly and in letters to members that this autocratic move was necessitated to prevent control of the Association by groups of foresters, groups of lumbermen, commercial interests, or other interests—neglecting to state that it was in fact *necessitated to prevent control of the Association by the public interests, for which alone foresters were working.*

It was to thwart the plan for securing just such control, by men who did not represent public interests, that these efforts were made by foresters. The charges made against the foresters are twofold—that they wished to control the Association, and that they represented a special interest. I categorically deny both charges, which were put forth for the purpose of throwing the burden of proof upon those who would no longer tolerate existing conditions. At the meeting in January, 1920, the greatest possible courtesy was shown to the officers and existing directors, and no attempt was made by the opposition to discredit Mr. Pack or his administration—in fact not a word was said except by the President and by Dr. H. S. Drinker and H. W. Kelsey, both of the latter speaking in favor of the President's slate while the ballots were being cast, Mr. Kelsey being one of the tellers appointed to count the vote. Many of the members were not satisfied with this policy of tolerance in the face of manifest evidences of carefully prepared steam roller methods employed by the chair, such as requiring a vote of those present before permitting any but the President's slate to be placed in nomination. Some of those present desired that publicity in the press be given to these conditions, but in the interests of the reputation of the Association this idea was suppressed, and the foresters agreed to continue their co-operation with the Association, which has been freely given during 1920 in the form of articles, editorials, and other support.

That this dissatisfaction was not confined to the foresters present is shown by a letter from Mrs. Mary L. Webster, of New York, a member who attended this meeting, and afterward sent in her resignation to Mr. Ridsdale. She writes: "Being an uninitiated onlooker, I was shocked at the performance, and wrote a criticism, sending my resignation. It seemed wrong for even the most casual subscriber to let such things go without a word." Mr. Ridsdale's reply to Mrs. Webster says: "I am not surprised to learn that you were disappointed in the annual meeting, where a number of foresters, in order to secure control of the Association from the administration which has built it up from an absolute nonentity and valueless organization to one which is a power for forestry and financially sound, monopolized, by their actions, the

time of the meeting, which might otherwise have been devoted to constructive discussions." Mrs. Webster's comment on this is: "Mr. Ridsdale absolutely turns what I wrote, a very scathing criticism of the meeting and magazine, into another interpretation."

Let us see what sort of control these "foresters" planned to secure for the Association on January 13, 1920.

There follows a comparative list of directors proposed respectively by Charles Lathrop Pack, and by a committee of members of the Association at New York, on January 13, 1920:

Mr. Pack's Slate (15 Directors)	Members' Slate (15 Directors)
Charles Lathrop Pack	Charles Lathrop Pack
W. R. Brown, Asst. Treas., Brown Co., Berlin Mills, N. H. Paper manufacturers	W. R. Brown
W. B. Greeley U. S. Forest Service	W. B. Greeley
H. H. Chapman Yale Forest School	H. H. Chapman
N. C. Brown, Forester American Wood Export Association, New York City	R. T. Fisher, Harvard Forest School
E. A Sterling, Forester, with John D. Lacey & Co.	C. D. Chapman, Forester, Sec. Oregon Forest Fire Protection Association
Alfred Gaskill, Forester, Commissioner of Conservation, New Jersey	J. A. Ferguson, Department of Forestry, Pa. State College
Chester A. Lyman, Vice-President, International Paper Co., New York City	Howard Weiss, Forest Products Engineer, Wisconsin
J. B. White, Lumberman, Kansas City, Mo.	Henry Hardtner, Lumberman, President, Louisiana Forestry Assn.
Henry S. Drinker President, Pennsylvania Forestry Association	Ernest B. Dane, Boston, Treasurer, Mass. Forestry Association
Charles F. Quincy Railroad Supplies, New York City	John B. Burnham, President, American Game Protective Assn., New York, N. Y.
Emerson McMillin, Banker, New York City	F. H. Newell, Former Chief, U. S. Reclamation Service, Illinois
P. P. Claxton, Commissioner of Education, Washington, D. C.	J. E. Jenks, Publisher of Army and Navy Register, Washington, D. C.
Standish Chard Lawyer, New York City	George D. Pratt, Commissioner of Conservation, New York City
Addison S. Pratt, Lawyer, New York City	Joseph Hyde Pratt, Director, North Carolina Geologic and Economic Survey

Thus Mr. Pack's ticket contained five professionally trained foresters, while the opposition slate contained six, two being on both slates. Two of Mr. Pack's foresters represented interests dealing in forest lands and lumber, two of the opposition foresters represented respectively an association of land owners for fire protection, and a consulting forester dealing in technical forest products. As against the remaining forester, Mr. Gaskill, in State forestry, the two opposition foresters were the heads of leading institutions teaching forestry. In what lies the effort to control? Comparing the remaining ten Pack directors with the nine opposition candidates we find on the Pack slate two large land holders, one of them a lumberman, one a paper manufacturer, two corporation lawyers, one banker, the Commissioner of Education in Washington, D. C., one dealer in railroad supplies, and Dr. H. S. Drinker, who is honored with the presidency of the Pennsylvania Forestry Association. On the opposition slate were one lumberman, Henry Hardtner, known through the South for his practical achievements in conservation both publicly and on his own lands; the former treasurer who had for six years, served the Association as a director but was dropped; a life member, Mr. Newell, and one of the founders of the Association; the heads of the conservation departments of two States, neither of them foresters; a man of national reputation as a conserver of wild life, and a banker who has been conspicuously interested in forestry in Massachusetts. The real difference in these two slates lay in the fact that one contained the names of eleven former directors all supposed to be favorable to Mr. Pack's regime, and of four new men selected by him, while the opposition slate retained but four of these old directors, and proposed eleven new names of whom but four were foresters.

Since February 25 efforts have been made by Secretary Ridsdale to personally discredit Director Chapman, and the statement has been made that he was the only inharmonious element on the board. This is possibly true at present, though I cannot speak for Director McMillin nor for the two newly elected men, Mr. Baldwin or Mr. Hammond, but in spite of the success of the President's slate, in which it would be supposed he could have secured a board which would give him united support, Director Gaskill as shown refused to accept his election, and Director Greeley on March 5 of this year resigned from the board, in a letter which he requested be published in *American Forestry* but

which was not so published. It remains to be seen whether Mr. Chapman is the only inharmonious element *left* on the board.

Again on February 25, 1921, with but six directors to elect to fill vacancies, there being at that time on the board four foresters holding over, the two slates proposed were, respectively:

Directors' Slate	Members' Slate
W. R. Brown for re-election	John B. Burnham, see above
N. C. Brown for re-election	F. H. Newell, see above
Standish Chard for re-election	John E. Jenks, see above
Addison S. Pratt for re-election	Wm. P. Wharton, Boston, Director Mass. Forestry Assn.
John Hays Hammond, Mining Engineer	Henry S. Graves, Former Forester, U. S. Forest Service
Elbert F. Baldwin, Editor *Outlook*	F. W. Besley, State Forester, Maryland

Thus the directors nominated one forester, the "foresters" two. Had the opposition elected their slate, the foresters on the board would have been increased from four to five, the extra forester serving merely to replace Mr. Gaskill. Mr. Greeley's resignation March 5 left as foresters on the new board, N. C. Brown, American Wood Export Association, New York City; E. A. Sterling, of John D. Lacey & Co., and H. H. Chapman.

It has thus been the policy even of the old board to have foresters as directors, but to have a majority of directors who were not foresters. This policy was accepted by those who sought to elect new directors, and at no time was any effort made or contemplated to control the board of the Association by, or in the interest of foresters, but solely by and in the interest of its members and the public whom they represent.

The second charge, that foresters represent a special interest, carries with it the corollary that this group is antagonistic to public interests and hence to the welfare of the Association, which, now that it is freed from their domination, can promote the cause of forestry and its policy of truly representing and creating public opinion.

It is my belief that the creation of public opinion is in truth the real object of these efforts described in this series of articles, *but in this purpose, and for the kind of public opinion to be created, foresters as a class are evidently to be excluded.* This raises the question in a very acute form, as to whom the public should trust. Who are these

foresters whom the public must be protected against, and who have run the risks of exposing themselves to the attacks of officers of the American Forestry Association as a means of increasing its prestige, its influence and its membership? We give a partial list.

Bernhard E. Fernow, the founder of forestry in America, recognized dean of forest education, first chief of the U. S. Forest Service when it was a Division in the Department of Agriculture, founder of the first professional forest school in America, editor and founder of the *Forestry Quarterly* (the first professional journal of forestry), and still editor of the JOURNAL OF FORESTRY, fearless foe of hypocrisy and sham in high places.

Gifford Pinchot, who with President Roosevelt established the National Forests, organized the personnel of the U. S. Forest Service, secured the control of waterpowers and of mineral lands in public hands and is feared by reactionary interests for his present fight in favor of regulation of private timber lands.

Henry S. Graves, for ten years chief of the U. S. Forest Service, who established that Service on an unshakable foundation and built up its personnel into an organization of exemplary efficiency—who first called public attention to the need for adopting the principle of regulation of timber destruction on private lands.

William B. Greeley, Forester of the U. S. Forest Service, who organized the Forestry Regiments in France and who has served as a Director of the American Forestry Association since 1915.

James W. Toumey, Director of the Yale Forest School and the entire staff of professors in that institution.

Ralph S. Hosmer, Director of the Cornell Forest School and the entire staff of professors of that institution.

Richard T. Fisher, Director of the Harvard Forest School.

This list could be extended indefinitely until it would include the great majority of foresters who unselfishly and in obscurity are "carrying on" throughout our vast land the preservation and the upbuilding of the country's forests.

What special interests do the four successive chiefs of the U. S. Forest Service represent, which are inimical to the public? What special interests do the Schools of Forestry at Yale, Harvard, Cornell, etc., represent against which the Association must be protected? What special interests do these State foresters represent, who have protested

against the present regime? What special interests does the profession of forestry stand for, which had its conception in an effort to serve the public, conserve our resources for the future and elevate the public conscience, who have allied themselves with the great forces of conservation and construction, and have striven for two or more decades to arouse the public to its danger? When this great body of professional men are found united, not in an effort to control a popular organization for selfish ends, but in condemnation of what they claim is the actual accomplishment of just such control, whom should the public believe? "Something is rotten in the state of Denmark," and it is time to do some house cleaning. Mr. Charles F. Quincy himself remarked some five years ago, "A Forestry Association which cannot retain the support of foresters will fail in its mission."

ERRATA.

The following errors were noted in H. H. Chapman's article, "Has the American Forestry Association lost its Usefulness?" published in the April issue of the Journal:

On page 334, line 6, *securities* should read *sources.*

On page 336, line 4, *cost* should read *net.*

SUGGESTION FOR REAPPROACHMENT

By W. R. Brown,

Brown Company, Berlin, N. H.

In the last issue of the Journal an attack was made on the policies, administration, and personnel of the American Forestry Association, of which I was then a director, and in reply I would ask the fair-minded readers of the Journal to reserve their judgment as to the matter until they hear the report which is to be submitted by a committee of investigation, a majority of whom it was voted were to be selected from the general membership. Personally, I am convinced that while they may find honest differences of opinion as to policy existing and perhaps some errors in judgment have been made that need rectifying, they will find that the administration has been honest and the personnel actuated by disinterested motives. Due to its long record of service and its present widespread potentialities for influence in creating forestry interest in the general public, it is my earnest hope that grounds of reapproachment be sought by both sides, with a reorganization and a policy adopted that will meet with the approval of all. I can see no reason why a reapproachment ought not to be possible concerning a substitute plan for permanent directors to make possible the acceptance of financial support and endowment, which must be acknowledged necessary and desirable, without undue influence over policy, by some plan of community trusteeship outside of the board, and so remove the necessity for the permanent directors, for which desirable end they were created solely as a continuing and responsible body, and with no purpose of controlling policy. As a second desirable reapproachment, the appointment of a professional forester as general manager, divorcing the business publication therefrom as a business in itself. As a third, the reorganization of the board by mutual consent by a new election of forward looking men, equally representative of the different phases of forestry interests, scientific, educational, commercial, and altruistic, so that all sides of the question may be adequately represented, so that free discussion may bring out fundamental truth, and a steady policy of advancement be promulgated in touch also with the practical as well as the ideal, intent on the widest patriotism coincident with fairness and justice to the present generation. I hope that this reapproachment may be

reached in a spirit of fair dealing and a tolerance of a difference of opinion, and a slowness to ascribe unworthy motives to an opponent who believes that the cause of forestry may be forwarded in what appears to him a more reasonable and practical way.

On my own behalf and in justice to my business associates, I simply want to call to Mr Chapman's attention that our company was the first private concern in this country to hire a professional forester about twenty-five years ago, to try out various systems of selective cutting and top lopping since then, to sell in the New England States timber reserves to the Federal Government, and last year inaugurated a system of planting two trees for each one cut in New England. Our determination to do this was not based on an idea it would be especially profitable. Also, call his attention to three laws passed the current year in New Hampshire; one for placing in the hands of the State Forester a slash disposal law for administration around camps, main roads, and between owners; the second to preserve seed trees on cut over pine lands; and third a law to make compulsory fire protection on owners of over one thousand acres of timber. I believe we have made progress in New Hampshire, because there was an honest desire of co-operation between the foresters and the lumbermen, and a willingness to believe the motives actuating each other were patriotic and unselfish. Figures on the cost of brush disposal in northern forests can be had from the experiments carried on by pulp companies in Quebec at the request of the Canadian Forestry Association. It would be interesting to verify their conclusions by experiment in New England, in which I would gladly join, to determine their relative value in cost and result obtained. My opinion as to just compensation for the public use of private property has been known for some years and naturally rests on the degree of loss sustained and the public necessity therefor, and as such is shared, I believe, by Colonel Greeley and most of the fair-minded foresters.

In conclusion, Colonel Greeley has taken a long step in advance in securing the co-operation of timber owners in support of the Snell bill, and can be relied upon to be fair in its enforcement, and ought to be supported in his very practical program by everyone in this country interested in preserving the forests. I believe timber users need foresters and foresters should not divorce themselves from timber users, and that attempts to create a line of cleavage between the two is unfortunate for forestry and that Mr. Chapman's general conclusion that timber users "cannot be expected to prefer the public interests in legislation to their own interests, much as they would like to do the fair thing," is not a fair statement of the case and that Mr. Chapman did not mean it in this way.

NATIONAL CONTROL OF FOREST DEVASTATION

An Analysis of the New Capper Bill

By Frederick E. Olmsted

On May 2, 1921, Senator Capper introduced the bill which is given in full below. It is based upon a careful study of the present forest situation by the Committee on Forests of the National Conservation Association. The following men served upon that committee: Gifford Pinchot, Chairman; R. C. Bryant, B. P. Kirkland, P. S. Lovejoy, F. E. Olmsted, J. H. Pratt, F. A. Silcox, R. Y. Stuart, and G. W. Woodruff.

The legal basis of the bill was suggested and developed by Philip P. Wells, after a thorough consideration of all other possible courses, and is considered sound by constitutional lawyers. It will be noted that the legislation now recommended differs in many respects from that of the original Capper bill. It is intended to serve as a comprehensive basis for final legislation and will, of course, be subject to change in the course of its progress.

67th CONGRESS, 1st SESSION. S. 1435

In the Senate of the United States

May 2, 1921

Mr. Capper introduced the following bill; which was read twice and referred to the Committee on Agriculture and Forestry.

A Bill to control forest devastation, to perpetuate forests in the United States, to raise a revenue from forest products, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

DEFINITIONS

That, when used in this Act—

"Commercial forest land" means all private land within the United States which is now or hereafter in forest, except farm wood lots as in this section defined, and except such land as the Secretary shall have caused to be examined at any time and shall have found to be at such time chiefly valuable for other uses than the growth of forest crops. And the Secretary is hereby authorized in his discretion to cause such examination to be made.

"Farm wood lot" means land which is a part of a farm, whether contiguous or not, and is used as a subsidiary source of farm supply or farm revenue, but which is otherwise like commercial forest land as defined in this section.

"Forest crop" means the wood of trees on forest land.

"Harvesting a forest crop" means the felling of trees on forest land, together with the production therefrom of one or more raw forest products and/or the removal of such products for sale, consumption, or use.

"Forest devastation" means the harvesting of a forest crop otherwise than in compliance with standards established by regional and local regulations made under section 3 of this Act.

"Operator" means any person who is engaged in the business of harvesting, or causing to be harvested, for himself, one or more forest crops on commercial forest land.

"Raw forest product" means the wood of felled forest trees, prepared for removal from the place of felling to be sold, used, or consumed, such as logs, poles, piles, round mine timbers, round or split posts, split staves, pulp wood, fuel wood, other cordwood, hewn ties, hewn timbers, bolts, and the like.

"Standard log scale" means such uniform scale for the measurement in board feet of the volume of all raw forest products as the Forester, with the approval of the Secretary, shall by regulations prescribe; and such regulations may provide for the conversion of measurements in any log scale, or in any cord measure, or in any other measure of raw forest products, into their equivalent in units of the standard log scale.

"Taxable product" means a raw forest product produced from trees felled on commercial forest lands by any operator.

"Standard product" means a taxable product produced from such part of a forest crop as is harvested in compliance with standards established and defined by regional and local regulations under section 3 of this Act.

"Product below standard" means a taxable product produced from such part of a forest crop as is harvested otherwise than in compliance with standards established under section 3 of this Act.

"Secretary" means the Secretary of Agriculture.

"Forester" means the Forester of the United States Department of Agriculture.

"Regional forester" means any officer or agent of the United States designated by the Secretary to perform the duties imposed on regional foresters by this Act.

"Person" means and includes a natural person, partnership, association, company, or corporation, and any officer, receiver, or employee of any of them, and any member of a partnership who as such officer, receiver, employee, or member is under a duty imposed by this Act or by any regulations under this Act.

FOREST REGIONS

SEC. 3. (a) That the Secretary shall divide, and may from time to time redivide, the United States into forest regions, which shall be delimited as he shall deem best in view of forest and economic conditions, in order that the standards established and defined by regional and local regulations under section 3 of this Act may be adapted to and applied in accord with local forest and economic conditions. The Secretary may conform the national forest districts to said forest regions.

ADMINISTRATION

(b) That the Secretary shall establish in the forest regions provided for in subsection (a) of this section, and in the District of Columbia, such service as he shall deem necessary for the administration of this Act; and, upon due request from the proper authorities of States with which the Secretary is co-operating under section 12 hereof, he may deputize State forest officials to assist in the administration of this Act.

HARVESTING REGULATIONS

SEC. 3. That in order that this Act may be applied locally in accord with regional and local forest and economic conditions—

(a) The Secretary shall make, and may from time to time amend, regulations establishing and defining in general terms as to each forest region such

reasonable standards for the harvesting of forest crops as he shall deem necessary to secure in such region a continuous succession of forest crops of reasonable quantity and quality.

(b) The regional forester of each forest region, with the approval of the Forester, shall make, and may from time to time amend, local regulations, not inconsistent with the regional regulations, establishing and defining as to any locality therein such reasonable standards for the harvesting of forest crops as he may deem necessary to secure in such locality a continuous succession of forest crops of reasonable quantity and quality.

(c) Standards established and defined by regional and local regulations under subsections (a) and (b) of this section may include such measures as protection of trees left standing, disposal of slash, reduction of fire hazards due to harvesting, temporary reservation from harvesting of such trees as may be necessary for the perpetuation of forest growth, or, on the request of the operator approved by the Forester, subject to conditions prescribed in such approval, reforestation by planting in lieu of such reservation, and the like.

(d) Before the making of regional regulations as to any region under subsection (a) of this section, the Secretary shall seek the co-operation of an advisory board as to such region, to consist of the State officials in charge of forest work in the States concerned and one representative each from such lumbermen's and wood-users' organizations as he may designate; and before the making of local regulations under subsection (b) of this section the regional forester shall seek the co-operation of a similar advisory board as to each locality, such advisory boards, at their option, to function as standing advisory bodies on matters relating to the practical application of the regulations and such admendments to them as may from time to time be advisable.

CLASSIFICATION AND RETURN OF TAXABLE PRODUCTS

SEC. 4. That every operator shall truly classify as standard products, or as products below standard, all taxable products produced by him during each year, and shall make return thereof as and when required by regulations under subsection (a) of section 7 of this Act.

INSTRUCTIONS IN 1922

SEC. 5. That the Forester shall, so far as practicable, cause to be inspected on the ground, during the calendar year 1922, harvesting operations on commercial forest lands, for the purpose of instructing operators or their agents on the ground in the method of applying the standards established by regulations under section 3 of this Act.

TAXES

SEC. 6. That for each calendar year after 1921 there shall be levied, assessed, and collected, and shall be paid by every operator, an excise tax on the privilege or franchise of conducting the business of harvesting forest crops on commercial forest lands, measured by the quantities of taxable products produced by him in such year, as follows: For the calendar year 1922, at the rate of 5 cents per thousand board feet standard log scale in respect of all taxable products; and for each and every calendar year thereafter at the rate of 5 cents per thousand board feet standard log scale in respect of standard products, and at the rate of $5 per thousand board feet standard log scale in respect of products below standard.

RETURN AND PAYMENTS

SEC. 7. (a) That on or before the 15th day of March, 1923, and each year thereafter, each operator shall make, under oath, return for the preceding calendar year, stating specifically the quantities, in board feet standard log scale, of standard products and of products below standard, respectively, pro-

duced by him during such preceding calendar year, from trees felled in his harvesting of forest crops on commercial forest lands. Such return shall be made in duplicate, one duplicate to the collector of internal revenue for the district wherein is located such operator's place of business, the other duplicate to the regional forester for the forest region wherein is located such place of business. On or before each such March 15 every such operator shall pay to such collector the taxes imposed by section 6 of this Act in respect of the taxable products produced by him during the preceding calendar year. The Forester and the Commissioner of Internal Revenue shall by joint regulations prescribe the form of such return and the form and manner of such payment.

ACCOUNTS AND RECORDS

(b) That the Secretary is hereby authorized and required to make, and may from time to time amend, general regulations governing the classifying of taxable products under this Act and requiring the making and keeping of such records and accounts and the making of such statements and reports under oath, other than the returns required by subsection (a) of this section, and prescribing such forms for such accounts, records, statements, and reports as he shall deem necessary for his information in the administration of this Act. No such accounts, records, statements, or reports, and no part of the information given therein by any operator shall be disclosed to any other operator or to the public except as may be necessary in the course of and as a part of legal proceedings instituted for the enforcement of this Act, or as may be otherwise required in pursuance of law, and except in statistical form without identification of persons.

FIELD INSPECTION AND EXAMINATION OF ACCOUNTS

(c) That the Secretary is hereby authorized to cause any officer or agent of the United States designated by him for that purpose to go upon and inspect any commercial forest land before, during, or after the harvesting of forest crops for all purposes connected with the administration of this Act, and the Forester and/or the Commissioner of Internal Revenue, for the purpose of ascertaining the correctness of any record, account, statement, report, or return required under this Act, or for the purpose of making the return where none has been made, are hereby authorized to cause any officer or agent of the United States designated by either of them for that purpose to examine any records, accounts, books, papers, or memoranda bearing upon any matter required to be included in any such record, account, statement, report, or return, and may require the attendance of the person making or keeping the record, account, statement, report, or return, or the attendance of any other person having knowledge in the premises and may take his testimony with reference to the matters required by law or by regulation under this Act, to be included in such record, account, statement, report, or return, with the power to administer oaths to such person or persons.

SEC. 8. That the provisions of sections 3164, 3165, 3167, 3172, 3173, and 3176 of the Revised Statutes, as amended by the Revenue Act approved February 24, 1919 (Statutes at Large, volume 40, pages 1146 to 1148, inclusive), so far as they are not inconsistent with this Act, shall apply to the administration of and proceedings under this Act: *Provided*, That no return in addition to the return required by subsection (a) of section 7 of this Act shall be required under the first sentence of said section 3173 preceding the first proviso thereof.

PENALTIES

SEC. 9. That every person who—

(a) Knowingly classifies any taxable product untruly or in violation of regulations made under this Act, or knowingly causes or permits such untrue or violative classification to be made; or

(b) Knowingly in any manner falsifies or causes or permits to be falsified any record, account, statement, report, or return required to be made or kept under this Act or regulations made under this Act; or

(c) Willfully refuses to pay or truly account for and pay over any tax imposed by this Act when and as required by this Act or by regulations under this Act, or willfully attempts in any manner to evade such tax—

Shall be punished by a fine of not more than $5,000 or by imprisonment for not more than one year or by both such fine and imprisonment in the discretion of the court.

CUMULATIVE PENALTY

SEC. 10. That any person found guilty under subsection (c) of section 9 of this Act shall, notwithstanding other penalties provided by law, be liable to pay the amount of the tax evaded or not paid, to be assessed and collected in the same manner as taxes are assessed and collected.

APPROPRIATION

SEC. 11. That appropriations are hereby authorized to be made annually out of any money in the Treasury not otherwise appropriated, to be expended under the directions of the Secretary for carrying out the purposes of sections 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 of this Act.

CO-OPERATIVE FIRE PROTECTION

SEC. 12. That the Secretary is hereby authorized and directed to recommend for each forest region of the United States the essential requirements in protecting timber and cut-over lands from fire, and is further authorized, on such conditions as he may determine to be fair and reasonable in each State, to co-operate with the various States duly adopting his recommendations, and through them with private and other agencies, in bringing into effect such essential requirements favorable for forest protection. In no case, other than for preliminary investigations, shall the amount expended by the Federal Government in any State during any fiscal year under this section exceed the amount expended by the State for the same purpose during the same fiscal year, including the expenditures of forest owners required by State law and approved by the proper State officials; and the Secretary is directed to withhold co-operation from States which do not comply in legislation and in administrative practice with such recommendations as shall be made in accordance with this section.

APPROPRIATION

SEC. 13. That appropriations are hereby authorized to be made annually, out of any money in the Treasury not otherwise appropriated, to be available until expended under the direction of the Secretary for carrying out the purposes of section 12 of this Act.

VOID PARTS

SEC. 14. That it is the intent and purpose of this Act that should any part thereof fail because of ambiguity or other reason, such failure shall not be construed as adversely affecting the remaining parts.

SHORT TITLE

SEC. 15. That this Act may be cited as the "Taxation of Forest Products Act, 1921."

A brief discussion of the terms of the bill will clarify its principal aims and the methods through which it proposes to control forest devastation. Special interest attaches to the question of how its various measures would work out in practice. The definitions in Section 1 should be studied with care, for they are important when interpreting the language used in the body of the bill.

DIRECT CONTROL AND DECENTRALIZATION

The crux of the bill, as compared to measures which advocate State control, is that the Secretary of Agriculture is given the power and authority to prevent forest devastation, and to prevent it at its very source, namely, wherever and whenever forest crops are harvested on commercial forest lands. That means direct National control over a thing that is working direct Nation-wide injury.

The Secretary is to establish such general standards for the harvesting of forest crops as he shall deem necessary to keep forest lands reasonably productive. To insure decentralization of administration, the United States is to be divided into forest regions according to the more general forest and economic conditions, and each of these regions is to be in charge of a regional forester to whom the power and authority of the Secretary is to be largely delegated.

The regional forester, with the approval of the Secretary, is to establish such standards and regulations for the harvesting of forest crops as local conditions may warrant, such regulations to differ with the many different forest and economic conditions within the region. An organization of this nature removes the actual supervisory work from Washington to the field, where it belongs.

ILLUSTRATIONS

Take, for example, the item of slash disposal. The Secretary might establish a general standard for a forest region to the effect that all slash must be disposed of in a way which would do a minimum amount of damage to the timber and young growth left standing, while leaving the cut-over lands in a clean condition and as safe as possible from fire. Under this general standard the regional forester would consider the conditions in the various localities of his region and, if desirable, could approve different methods of slash disposal for different localities, or even for different operations in the same locality. In one case he might call for the piling and burning of slash in small, compact heaps; in another, the brush might be piled in wind-rows and

burned; in still another the tops might be lopped and the branches left as they fall; or the slash might be burned broadcast, or scattered without being burned, and so on, and so on. In each case due consideration would be given to the cost of the operation when compared to the results obtained and to market factors.

In a similar way the problem of the temporary leaving of trees would be considered. The Secretary, for example, might establish a standard for a region which would provide that trees must be left standing after harvesting in such numbers and so distributed as to give assurance that forest growth of a reasonable quantity and quality would be continued. The regional forester would then consider the needs of the different types of forest growth within his region, approving such measures for the temporary reservation of trees as the peculiarity of each type might suggest. There would be instances where a certain part of the stand should be temporarily withheld from cutting in order to make sure that the lands are kept productive, and in such instances a part of the stand might be reserved in the form of scattered seed trees, or by groups, or according to diameter limits, and so on, and so on. There would be other instances where a continuous succession of forest crops might best be obtained by cutting the stand clean, leaving no trees in reserve at all. There are types of forest growth where a natural reproduction follows clear cutting, and other types where planting would be necessary. At the operator's request the Secretary might approve clear cutting and planting, under conditions to be fixed by him. And here again, in all these cases, the cost of the temporary reservation of trees would be weighed against the results to be obtained and the market conditions which control the operations. In other words, the procedure will be practically the same as that prevailing now in the control of cutting in National Forests.

Many operators would doubtless desire to prepare their own silvicultural plans and submit them for approval. In case these plans embodied such standards as might be approved by the Forest Service, the operators would proceed under them, and the Service would simply inspect the operations from time to time in order to see that the standards were maintained. In this way the Government's task would become lighter and lighter as time went on.

NO RIGID BUREAUCRATIC REGULATIONS ARE LAID DOWN

This general scheme has the advantage of being elastic in character, and avoids fixed, cast-iron regulations for the country as a whole. It

enables each forest tract to be treated in a way best suited to its own peculiar needs, through measures involving the least possible cost. It is justified by experience, having proved successful on the National Forests for the past fifteen years. It also has the immense advantage of allowing us to start the control in a simple way, providing at first for such measures only as are obviously desirable and essential, readily understood, and simple in application. As time goes on the forest operators will become more and more familiar with what the law requires of them and, more important still, will see that the measures to be applied work directly to their own substantial gain. Forest management, then, may be improved gradually as circumstances warrant.

It should be borne in mind that the passage of this Act would be followed by a period of one year during which the operators would be instructed as to the measures to be enforced after that year has elapsed.

CO-OPERATION

All Parties Concerned Have a Voice in Passing Upon Standards and Regulations

In establishing and applying the standards and regulations the Forester and regional foresters would have the advice and assistance of advisory boards, upon which would be the State foresters concerned and representatives from the lumbering and wood-using industries. It is probable that these boards would become standing committees, with functions much like those of the boards of cattle and sheep owners which have co-operated successfully with the officials of the National Forests for many years. This is another detail of administration which conforms to established practice.

ORGANIZATION

The District Foresters and State Foresters Are a Part of the Organization

The bill is so framed as to make the organization a simple one. The Secretary and the Forester would be concerned only with the larger principles of organization, for the bulk of the executive work is left to the field officers. The organization necessary for supervision and inspection might well follow the general lines of that now in effect for the control of timber sales on the National Forests, although it need not, of course, be anything like as intensive. District forest

rangers would naturally be the active local men on the job, advising with the operators, assisting in the application of measures for forest perpetuation, and reporting from time to time on the character of the harvesting and the condition of the cut-over lands. A few regional inspectors would doubtless be desirable, in order to unify and check up the work of the district rangers. The regional foresters would be the executive officers in charge, and in regions where National Forests are located this office might well be combined with that of district forester.

Based on past experience in similar problems, it is estimated that a force of from 700 to 800 men would be ample at the start, and that a smaller number could probably swing the work. This does not mean that 700 new Government officials would be necessary, for a part of this force might be drawn from the existing personnel of the Forest Service, and another substantial part might come from the various States having trained forest forces. Remember that the Secretary may deputize State forest officers to assist in the administration of the Act and might, for example, make use of the entire forest force of any State as a unit, provided the State consented to act. The total number of new Federal officials, therefore, would be small.

COSTS

No New Public Burden Is Involved

The cost of administration, including overhead expense and such scaling as may be necessary of wood cut in devastation, is estimated at about $2,000,000 per annum, an amount which would be covered, approximately, by the collection of the tax of five cents per thousand board feet. Neither in this connection nor in the clause for co-operative work in fire protection are specific appropriations called for. The amounts are omitted in order to conform to the new procedure for appropriations in Congress. Definite sums will be written into the bill at the proper time.

PROTECTION AGAINST FIRE

Reduction of Fire Hazards Due to Harvesting

Measures to minimize the danger of fire when forest crops are harvested should, of course, enter into the standards and regulations established by the Secretary and regional foresters, and would be similar to the various precautionary measures now enforced in timber

sales on the National Forests. This is referred to in Section 3 (c), in the phrase "reduction of fire hazards due to harvesting."

General Fire Protection.

Quite apart from the above measures, it is of course essential that adequate and systematic plans for the prevention and suppression of fires *on forest lands in general* be provided for. Here we are dealing with conditions which differ distinctly from those connected with the harvesting of forest crops, where the timbered States never have and never can act efficiently. Most of the forested States have long since passed laws for the protection of forest lands against fire, and have maintained field forces for the execution of these laws. Many of the States are already receiving Federal funds, under the Weeks law, as an aid to fire protection work. It is logical, therefore, simply to strengthen the existing forest fire State administrations, and to specify that the State laws and the manner of their execution must attain the standards set by the Federal Government before financial assistance is granted. With the Federal and State Governments working in such close co-operation as this bill provides, both on harvesting and fire control, it is fair to assume that all the forces would soon be running smoothly as one machine. An annual Federal appropriation of $1,000,000 for co-operation with the States in protection against fire will be requested.

ENFORCEMENT

Follows the Federal Income Tax Law.

Concerning the classification of products, returns, payments and records the terms of the bill are similar to those of the Federal income tax law; the provisions referred to in Section 8 cover these points. These include penalties of 25 per cent for willful neglect to file returns and 50 per cent for filing a fraudulent return.

The responsibility rests with the operator for classifying his raw forest products as standard or below standard, for making returns and payments accordingly, and for keeping the necessary records. The Forester and Collector of Internal Revenue are authorized to make such field and office inspection as may be necessary to assist the operator to comply with the law, and to check his woods operations and office accounts.

It will be noted that the penalties apply to the classifications, records, and payments, not to the products harvested in devastation. Most

operators, we assume, would prefer to pay the tax of five cents rather than that of five dollars per thousand feet, and, as a consequence, most of the harvesting of forest crops would be done according to the standards established.

FARM WOODLOTS

Farm woodlots are excluded from the terms of the Act because most of them are already managed in a fairly conservative way, making the necessity for their control of less immediate importance; and because the difficulties of control from an administrative standpoint would be out of proportion to the results obtained, at least for some time to come.

OTHER LEGISLATION

It should be distinctly understood that this bill is not, in itself, a complete forest program for the Nation. It is confined to the one thing of immediate and vital importance, namely, the prevention of forest devastation on privately owned commercial forest lands, and is intended to create a clear-cut issue on that fundamental problem. In order to realize a complete national forest program, legislation on the following matters is desirable:

1. The acquisition of forest lands by the United States and their inclusion in National Forests.
2. Logging and milling operations by the Forest Service on National Forests.
3. Forest research.
4. The reforestation of devastated forest lands.
5. A survey of the forest resources of the country.

In view of legislative procedure, these subjects must be considered in separate bills, or must be grouped in two or more bills. The National Conservation Association, through its Committee on Forests, will either present for consideration bills covering these additional problems, or will support such other satisfactory measures as may be introduced.

BUSINESS METHODS TO DISTRIBUTE BURDEN OF FOREST RESTORATION

COMMENTS ON THE SNELL BILL

BY HARRIS A. REYNOLDS

Secretary, Massachusetts Forestry Association.

The problem of conserving and restoring our forest resources is, at this stage, primarily one of salesmanship. For more than twenty years we have been trying to sell this proposition to the tax-payers but the progress has been so slow that our forest capital has steadily decreased. This experience would indicate that something is fundamentally wrong with our analysis of the problem or method of attack. Were we representing a commercial corporation, which had to pay dividends, it is doubtful whether our services, as salesmen, would be continued.

There are certain principles which a salesman must follow if he would succeed; namely, first, he must obtain the favorable attention of his prospective customer; second, awaken an interest in the article in the mind of the customer; third, create a desire for it, and finally he must get action. Applying these principles to our problem of forest conservation, we find some States in which we have not yet got even favorable attention to our proposition. In a greater number, we have aroused a general interest only. In some there is a genuine desire that something shall be done to conserve these resources, but effective action has been taken in very few cases. There are various methods of securing the favorable attention of the public, of arousing its interest, and of creating a desire on its part for a given public project, but we will not discuss those phases of the salesman's art here, because we are primarily interested in the final step—action.

It will require billions of dollars to bring back the forests of this country and protect our remaining supplies of timber. That money must come from the tax-payers and to get it and get it quickly is the problem of today. We are proud of our National Forests, but with the exception of some $12,000,000 spent for purchases in the White and Southern Appalachian Mountains, Congress has simply changed the name, and to a degree the status, of these great public areas. The

creation of the National Forests was a very important step, but from now on we must get money in liberal amounts from the public purse if we are to advance this work as we should.

Consider the methods we have used in our efforts to obtain appropriations for forestry from our State legislatures. Usually, at first, the amount of money requested for a project is about one-tenth or less of what we know is needed to do the job. It is too small to attract the attention of the leaders in the legislature and too large to get by the conservatives. The result is either a complete failure to secure any appropriation, or a great reduction in the amount requested. It is almost always too small to make a creditable showing in the field, which is the most telling, and in fact, a necessary argument if appropriations are to be increased or continued. Furthermore, the proponents themselves having been baffled or at best given scanty consideration in their first attempt, approach the problem of securing increases with timidity. Again they ask for an insufficient sum and the former experience is repeated. In the meantime, the forests are being devastated by the lumbermen, fires are following in their footsteps, regeneration is neglected, and the forest capital of the State is diminishing. A glance at the history of State forestry will show the accuracy of this statement. The exceptions only prove the rule, because the States that have made the greatest progress in this line are the ones that have had the courage to make large demands. We have not always stood by our convictions. A weak demand for legislation is merely a signal to the politicians to kill it. On the other hand, a bold front before a legislature is as necessary for success as in a military campaign.

To secure sincere and effective action is where the art of the salesman is put to the test. It is his purpose to drive as good a bargain as to terms as possible and the ideal arrangement is cash, but he is prepared to offer a part payment or even an extended credit plan. Curiously enough with the experience of Europe to guide us, where money is borrowed for forestry work, we have almost invariably insisted on direct appropriations for the purchase and reforestation of lands for National and State Forests. We have failed to profit by the example of the business world. A very small part of the business of the country is done on a strictly cash basis, and there is no good reason why the forester should not adopt this principle in his public work.

Let us glance at the problem of forest restoration. Our timber supply under present conditions will last about fifty years. A rough estimate of our forest producing lands is 463,000,000 acres of which something over 160,000,000 acres is now publicly owned. At least three-fifths of our forest producing land should be in public ownership—Federal, State and municipal—to insure perpetual management and maximum production. The country cannot afford to leave the production of one of its basic industrial materials to private initiative where the period of production is so long as to generally necessitate a change of ownership during the growth of the crop. Therefore, within the next twenty-five years at least 100,000,000 acres should be purchased and reforested by the Federal, State and municipal governments. To buy this land, reforest it, and protect the growth from fire, insects, and fungi, will probably cost over $2,000,000,000. We cannot expect to secure that amount of money by direct appropriations within the next twenty-five years. When we consider that the taxpayer is, and will be for many years, burdened to the limit with war debts it is not only doubtful whether we can persuade him to make the necessary appropriations to carry out this program, but it is unfair to expect him to assume all of this burden. We owe something to future generations, but the expense of this proposition is so great, and the financial return to the present generation so small, that those who are to reap the profits should be required to meet a part of the cost.

It is customary in the development of public works of unusual magnitude, such as the building of water-supply systems, sewage disposal plants, subways, bridges, school houses, and the like to sell bonds maturing at some distant date depending upon the character of the project in hand, so as to distribute the cost on an equitable basis among those who are to benefit by such improvements. Is this system not applicable to the reforestation of our idle lands? A growing forest is an investment which constantly increases in value from the day it is planted until it is ready for the axe. There is no depreciation such as we find in buildings, roads, bridges, and water-supply systems for which we regularly sell bonds. Instead of passing a burden on to future generations we will really be giving them a heritage. Unlike an industry which depends for success of production upon human agencies, nature, which produces the trees, is not affected by strikes, over-production, death of managers, or the inflation of the currency.

The financial risk in proportion to the amount invested is less in this project than in many other conservative business ventures. Nearly a third of the cost of the land and the planting, the initial investment for which bonds should be sold, is the cost of the land itself. On it there can be no depreciation because in most cases it is considered almost valueless today. It is producing little of value to its owners and scarcely anything for the Commonwealth in taxes. Hence, under forestry management, its value must naturally increase and this increment will go to the public which owns the land. Of course there are risks due to fire, insects, fungi, and climatic conditions, but these dangers must be met anyhow even though direct appropriations are made from time to time. Calamities such as the chestnut blight cannot be foreseen but the knowledge we now have of forestry, fire prevention, insects, and fungi, will enable us to avoid pitfalls which we might have stumbled into twenty years ago. The fact that these forests would be widely distributed, would likewise distribute the risk due to fire and other local disturbances. If we truly believe that reforestation is a profitable business undertaking we should not be timid in recommending that the work be undertaken on a large scale. Once the State has made a large investment in reforestation it will no longer be niggardly about making appropriations to protect that investment. The benefits from timber production are such that forest conservation should be self-supporting, and the money put into it should be treated as an investment and not as an expenditure.

Presented in this light the public—our prospective purchaser—will be more ready to enter upon a program for forest restoration on a scale that will meet the need then if it were asked to pay cash. This proposition is one which will benefit our children more than ourselves, and our policy of demanding direct appropriations for reforestation is comparable to asking the citizens of a town to pay for a huge reservoir now, which they know will be needed in the future, but which cannot be used to advantage during their lifetime. We are not accustomed to shortages in any of the natural resources in this country and consequently the average citizen cannot see why he should be taxed to meet some future calamity which we believe may overtake the next generation, and therefore he is inclined to take our warnings with a grain of salt, or as the fulminations of enthusiasts.

When the legislature of Massachusetts was petitioned last year for a law to provide for the purchase and reforestation of 250,000 acres

of idle lands, a plan was worked out for financing the project which seemed to meet local requirements. This plan proposed that the cost of the land and the planting should be met by bond issues from year to year and that the cost of maintenance should be covered by direct appropriations from the State treasury. This seemed to be the most practicable and equitable distribution among the generations to be benefited, of the burden of restoring forests to our now idle lands.

By this arrangement the present taxpayers were asked to pay but little more, even though lands were bought and planted on a large scale, than they would have to pay to protect this idle land. It costs just as much to protect scrub growth from fire as commercial species, and this scrub must be protected in order to safeguard other valuable property.

The plan at once eliminated the chief objection of legislators—the cost. It divided the outlay between direct appropriations and bonds approximately on the basis of two to three, the bonds with compound interest amounting to about three-fifths of the total cost of producing the crop, which would be redeemed at the time the timber was cut.

Massachusetts has a law which provides that all bond issues of the Commonwealth must be paid on the serial payment plan. For instance, every bond issue is divided by the number of years it is to run, and the quotient is the amount that must be paid each year during the period.

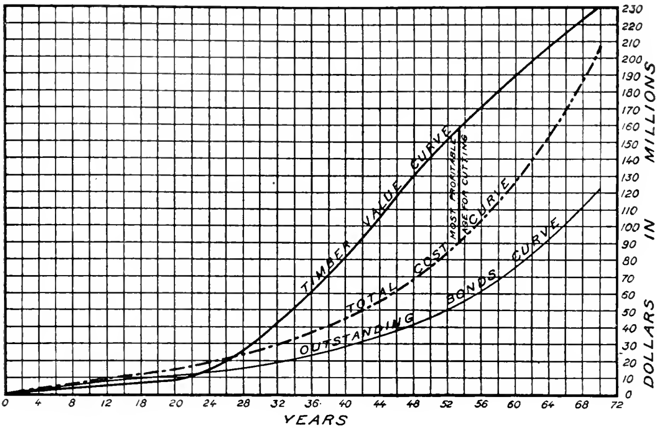
Taking this law as a starting point our plan proposed that 25,000 acres be bought and reforested each year for a period of ten years. Enough bonds were to be sold each year to meet the expense of purchase and planting for that year. Each bond issue was to cover a ten-year period, but any other period might have been selected or the period might have varied with each issue. This short period was selected as a basis of calculation because of the prevailing high rates of interest. One-tenth of the first issue therefore would have matured the following year. In order that the total cost of the land and the planting, including compound interest, might be carried along to the time of harvesting the crop, the plan provided that enough bonds should be sold each year, first, to meet the cost of land and planting for that year; seconding, to cover the maturities falling due on all previous issues that year, and finally to pay the interest due on all outstanding bonds. When the eleventh year was reached, the purchase and planting having been accomplished, there would be no need for further money

for that purpose. In that year and each succeeding year, however, there would be a bond issue to cover all maturities for such year and the interest on the outstanding bonds. This process would be continued until these maturities and interest could be met from the profits on the sale of the timber grown. The land under forestry management would be restocked mainly by natural regeneration and the second crop would be started without the necessity of selling bonds. We would then have accomplished the restoration of our timber producing areas.

The bond issues were figured on a five per cent interest basis, which is a much higher rate than the normal. The cost of maintenance was to be met by direct annual appropriations, estimated at seventy cents per acre per year and this was intended to provide for complete protection against all known dangers, to pay the taxes, to make the necessary improvements, and to offset unavoidable losses. Besides, compound interest at five per cent was allowed on these annual appropriations in making up our total cost curve. These estimates were extremely liberal, but they were made in this manner to meet all possible objections from the legislators.

In figuring the value of the timber that would be produced, we took the white pine as the basis of calculation because it is our predominant timber species. There again we figured conservatively, taking as our basis of production the yield on third quality site which averages 751 board feet per acre per annum on a fifty-year rotation. White pine stumpage was selling at $15 to $18. We estimated that fifty years hence it would bring, in the average location, $20 per thousand. One lumberman and manufacturer of life-long experience stated at the hearing that in his judgment white pine would bring at least $50 on the stump fifty years hence. Therefore, taken from every angle, our estimates of costs and values were exceedingly conservative.

The total cost curve and the timber value curve were farthest apart at fifty-four years which meant that this was the most profitable time to cut the timber, or in other words, the financial rotation for white pine, based on the factors used in our calculation. The total cost to that time for the 250,000 acres was $91,000,000. The timber value curve showed at that period $159,000,000, or a net profit to the State of $68,000,000, a little over $5 per acre per year.



EXPLANATION OF ABOVE CURVES.

A. Timber Value Curve. This curve is based on the amount of white pine timber which can be grown on third quality land; and that white pine will be worth at least $20 per thousand board feet on the stump at the time of cutting.

1. The amount of white pine timber which can be produced on third quality land is taken from foresters' tables prepared from actual measurements. It is certain that a considerable part of the land which will be bought will be either first or second quality for timber growth and will produce from 30 per cent to 50 per cent more in 50 years than the curve shows.

2. The estimated value of $20 per thousand board feet at the time of harvest is considered ultra-conservative because in some sections white pine stumpage is bringing from $15 to $18 per thousand board feet today. It is the opinion of some lumbermen that in 50 years the price of white pine stumpage will be more than double this estimate.

B. Total Cost Curve. This curve shows the total cost of the project up to any time during the period of production and includes the outstanding bonds which cover the cost of land and planting with compound interest at 5 per cent, plus the total cost of maintenance at 70 cents per acre per year with interest at 5 per cent compounded annually. To determine the cost for any year follow the vertical line from that year to the curve and from that point on the curve follow the horizontal line to the dollars column at the right.

C. Outstanding Bonds Curve. This curve represents the total amount of bonds outstanding at any time during the period of production, for the expense of the land and the planting, estimated at $25 per acre, with interest on that sum at 5 per cent compounded annually.

It will be noted that the Timber Value Curve and Total Cost Curve diverge after the twenty-seventh year up to about the fifty-third year, and after that time they again approach each other. This means that up to that time, the timber value is increasing faster than the cost including compound interest, but after that time the compound interest increases more rapidly than the value of the timber growth. Therefore, the most profitable time to harvest the crop, is when these curves are farthest apart, which is between fifty-three and fifty-four years, according to our premise. This is technically known as the financial rotation.

As a matter of practice the cutting would extend over a period of ten years or more, and all the land would not be given over to white pine production, which would probably reduce to some extent the net profit. But $68,000,000 is a fair margin of net profit on a $91,000,000 investment, and if under the most adverse conditions the State should only break even on the financial side, the fact that this timber had been produced on land which otherwise would have remained a waste would make it a paying business for the public. The use of this timber in the industries, the protection of the water supplies, the recreational value of these forests, are only a few of the by-products of this enterprise. It would create an industry employing several thousand men, and would help to bring back to use many of the abandoned farms, besides retaining the wood-using industries in the sections where such forests were created.

The Massachusetts legislature did not accept this plan last year although the Committee on Agriculture reported it unanimously. When it came before the Ways and Means Committee, the President of the Massachusetts Bankers' Association, the United States Forester, Colonel W. B. Greeley, leading lumbermen, paper manufacturers, wood-using manufacturers, farmers, sportsmen, representatives of labor, chambers of commerce and other organizations appeared in favor of the bill and of this plan for financing the project. There is no doubt that the members of that committee were convinced of the soundness of the financial schedule, but the legislature had just voted a bond issue of $8,000,000 for the purchase of a subway, and politics decreed that the people might not understand, if further bond issues were approved. Hence the plan fell a victim to political expediency. On the other hand the legislature did recognize the justice of our demands and the necessity for some action, and accordingly authorized the expenditure of $3,000,000 for the purchase and reforestation of 100,000 acres in fifteen years.

If the sale of bonds for forest restoration is practicable, and many foresters and business men agree that it is, are we justified in continuing to ask for direct appropriations for this work? With 81,000,000 acres of idle, potential forest land in the country surely the National Forest area should be increased by at least half that amount. The land so purchased should be planted where necessary as soon as possible, and millions of acres in the present National Forests should

also be reforested. This program should be carried out within the next twenty-five years in order to meet the need. There is not the slightest danger from overproduction. It will cost close to $1,000,-000,000 for acquisition, reforestation, and the protection of these growing forests from fire, and we cannot get that much money by direct appropriations. If the Treasury Department were authorized to issue bonds upon the recommendation of the National Forest Reservation Commission, within some limit in money or work accomplished, the Commission could then formulate a program and carry it out as rapidly as economically practicable.

The Snell Bill, now before Congress, tackles this problem of forest restoration in a comprehensive manner. It is a splendid enumeration of the things desired, and is in fact more of a forestry platform than a bill. As a bill it contains inherent weaknesses or internal stresses which may jeopardize its passage. While it is claimed that the bill does not aim at the regulation of the lumber industry, yet the Secretary of Agriculture is authorized to recommend essential requirements in the cutting and removing of timber crops and may withhold co-operation from any State which does not comply in legislation or in administrative practice with those requirements. In practice, therefore, the Secretary of Agriculture could demand such regulation and if not adhered to he could withhold co-operation, thereby defeating an important purpose of the law. The lumbermen know that they have little to fear from State regulation, and hence many of them support the bill because of the other advantages, such as fire prevention, which they will receive from the law. But, unless these requirements are met by the States this provision of the law will be nullified.

The amounts requested by the bill for fire prevention and reforestation are inadequate if fires are to be effectively prevented and our idle land is to be set to work producing timber. The acquisition item is probably too large to receive favor in Congress because it must be a direct appropriation, and if this item is cut, it is a fair assumption that the other items, some of which are already too small, will also be reduced.

If this bill were considered as a forestry platform, which it really is, the various provisions would naturally fall into one of three bills, namely:

1. A bill to provide for the acquisition of lands for National Forests, and the reforestation of National Forest areas, the cost to be met by the sale of bonds. (This method of meeting the cost is not mentioned in the Snell Bill.)

2. A bill to provide for a survey of forest resources, and general co-operation in fire prevention and research.

3. A bill for the regulation of the cutting, removal, and conservation of our remaining timber, and of other functions of the lumber industry.

By following this course the failure of one of these bills would not endanger the others. But, if they are all coupled together as at present, opposition to one of these items may drag all the others down to defeat with it.

The bill for acquisition and reforestation would probably receive general support, the inertia of Congress being the chief obstacle to overcome. The question would arise whether the proposition was of sufficient urgency and size to justify the sale of bonds for the purpose. It should not be difficult to prove the gravity of the case; in fact, the Capper Report already has proved it. With Congress in a mood to practice economy, and the taxpayers crying for relief, an opportunity to shift some of this burden to the future citizens would be welcomed. Of course it would have to be shown that it is a proper subject for the sale of bonds and that it is a reasonably safe investment.

Under the bill for co-operation, survey, fire prevention, and so forth, the provisions mentioned in the Snell Bill might be consolidated and clarified; the amounts requested for the various activities should be reapportioned; and the big sum asked for acquisition and reforestation having been eliminated by the bonds from the direct appropriation class, more money if desired could safely be requested for some of these items such as fire prevention.

Finally, the regulation bill would put that proposition on its own feet. It would no longer be looked upon as a dangerous rider, and whether or not regulation is necessary or desirable at this time would be determined by the facts. If it is necessary, it should be adopted regardless of these other measures. If it is not necessary, the public should not be required to swallow it in order to get what it desires and must have.

To return to the original statement that this is a problem in salesmanship, the Snell Bill places the salesman in the position of insisting that the customer must buy some persimmons in order to procure the plums which he is anxious to have the customer accept. The persimmons might be very desirable but they should be presented for sale in a separate container.

COMMENTS.

By E. A. Sherman, *Associate Forester*

While I feel there is a great deal of merit in Mr. Reynolds' suggestion as to bonding, and while it seems to be undoubtedly well adapted to Massachusetts conditions, I do not believe it would be wise to extend the same idea and the same plan to Federal acquisition of forest lands. In the first place the adoption of such a plan for financing the nation's program of reforestation is not only unsuited to the present financial status of our country but in addition would have an immediate bad effect upon business conditions generally.

The billions of war bonds issued by the United States are now in the hands of millions of our people. In addition, the Federal Government has considerable floating indebtedness. Public revenues are being raised on the basis of reducing the floating indebtedness and will be continued upon the basis of providing for the payment of the bonds when due. I suppose that our Federal debt will be reduced at the average rate of approximately five hundred million dollars a year, beginning at least with the next fiscal year. Bonds are now below par. Any proposal to increase our bonded indebtedness would meet with strong opposition and would unquestionably result in loss to innumerable small investors. The relatively modest amount needed for silvicultural rehabilitation which, including all activities, will mean a charge of from ten million dollars a year to an ultimate possible one hundred million dollars a year. This expenditure would result in reducing the annual payments on our public debt by not more than 20 per cent.

Furthermore, considering our present financial condition, it does not appear that there would be any particular advantage in the bond issue. If we should issue bonds we could pay off just that much more of the existing debt, but our indebtedness would be increased by the equivalent amount of bonds. If we do not issue bonds, we pay off

just that much less of the existing debt, but we incur no new obligation.

Furthermore, even if our financial situation were different, I am not at all sure that I would approve Mr. Reynolds' plan of a bond issue for National Forests. It does not appear to me to be exactly the right thing for us to pass this obligation on to the next generation. Massachusetts is such an old State and the day of her primary silvicultural sins is so far past that her present generation may with some show of reason disclaim responsibility for the deplorable condition of her forests. Consequently it may be quite fair to pass the financial burden of rehabilitating the forests on to the generation that will reap the benefits of the investment. But for the nation as a whole to adopt such a policy, while still continuing the ruthless devastation of our virgin forests and while still allowing each year thousands of forest fires to burn unchecked, does not appeal to my sense of justice. I realize the justice of passing on to posterity a portion of the burden of paying for improvements which posterity will use, but to pass on to posterity the financial burden of repairing the destruction which we have caused seems to me to be quite a different matter. It seems to me that each generation that tenants the earth may reasonably be expected to repair the physical damage it does to the property while occupying it. Consequently, when this generation shall have repaired the damage it has done to the forests of the country, it will then be time enough to suggest issuing bonds and requiring future generations to pay the cost of further forest "improvements."

Suppose we now engage in an extensive national campaign of reforestation and put it over on the basis suggested by Mr. Reynolds. Then consider the feelings of gratitude with which your grandson will at some future day say: "My grandsire, peace to his ashes, enjoyed the use of forests of trees hundreds of years old. They were nature's free gift and cost him nothing. He was not selfish nor was he unmindful of posterity. Oh, no! While he was cutting down the last 137 million acres of his free virgin forests he took thought of the needs of his children and of his grandchildren. Yea, truly; but he was also a thrifty soul, so he cannily contrived a method by which he could transmit to me the natural resources essential for my economic well-being, and I find that this gift is very neatly tagged with a bill for the original price paid by Grandpa and all intervening expenses with interest com-

pounded to date. This I am expected to pay by redeeming the bonds with which he financed his benefactions."

This feeling of gratitude would not, I fear, be so tremendous as to cause him to erect a marble monument to the memory of your generosity. Nor am I sure that he would be entirely satisfied because of the co-ordinate advantages resulting from the fact that his grandsire was so lavish in the area of forests that he cut and destroyed and so conservative in the acreage that he planted and protected that when the gift reaches the bonded recipient he finds that the timber, because of its scarcity, is now valued at $50 per thousand on the stump, and is only bonded for $20 per thousand. Really he might be excused for raising the question, "If Grandpa charged me $20 per thousand stumpage for my timber when he got his for nothing, what would he have charged me if he had been required to pay something for his own supply?" Then he might look back through his history and finding it recorded that the period following the World War was known as "The Age of the Profiteer," would shake his head sadly and say, "I fear dear old Granddad was one of those profiteering folk. Anyhow he certainly threw the hooks into me good and plenty."

COMMENTS ON SHERMAN'S COMMENTS

By Harris A. Reynolds

I agree that the plan outlined for Massachusetts should not be attempted as a National program, because it would require the sale of bonds from year to year to meet interest charges on previous issues which would be too small for the Federal Government to bother with, while it would be appropriate for a State. It was not my intention to imply that the Massachusetts plan should be employed by the Federal Government, but simply cited it in detail to show the principle. The bonds sold by the Government would cover a long period; long enough to produce a crop, and the interest on them would be paid from current revenue.

I can't agree that the sale of bonds for this purpose "would have an immediate bad effect upon business conditions generally" because once the principle of bonding this project was adopted the bonds would be sold as needed. For two or three years, while the work of purchase and reforestation was being organized on a large scale, the sale of bonds would probably not exceed $25,000,000 per year. Within

the first ten-year period, however, the sale of bonds might mount to the annual maximum of $100,000,000 which Mr. Sherman mentions.

These relatively small issues could have no great material effect upon the financial or business conditions of the country. Whatever effect they would have upon the business conditions would be beneficial, especially in the sections where the money was spent, by putting more money into circulation in those sections and by furnishing employment to thousands of men in those communities.

True, the Government has a huge debt, but it is saving millions by buying its own bonds now below par. By doing so it is trying to help the investor because its purchases is a big factor in stabilizing the market and holding the price at a higher selling point than it otherwise would be. Therefore it would be good business for the Government to sell *reforestation bonds* now, maturing at a distant date, in order to have more of its present revenues free to be used in buying these war bonds below par.

Mr. Sherman admits that the proper expenditure for "silvicultural rehabilitation" now, from current revenues, would reduce the Government's ability to cancel its war and floating indebtedness by about 20 per cent, which when we consider that for every dollar spent now for the purchase of bonds the Government realizes a saving of from 10 to 15 per cent is a very considerable item.

It is also true that issuing bonds for reforestation, at the same time that we are paying off war bonds, would leave our indebtedness the same, to the extent of the bonds sold, but the indebtedness would be of a highly different character. Our war indebtedness must be charged off to public safety, advertising, and international good will, which have great intangible values, but the reforestation bonds will be met directly from the profits on the crop produced, and will not have to be met by taxation of the future citizens as we are now meeting the war indebtedness. It would seem, therefore, that this change in the character of the Government's indebtedness would be a very desirable thing.

It is evident that Mr. Sherman did not analyze my article very carefully because he seems to have read into it several things that are not there. For instance, he implies that I would have the Government sell bonds for fire prevention, which, of course, should be borne by the present generation, and I think it was made clear in the article that such expense would be met from current revenue. In his exceedingly humorous reference to what "grandson" would say, he stated

that the bonded indebtedness which "grandson" would have to pay would be $20 per thousand feet, while as a matter of fact that figure referred to the probable stumpage value 50 years hence. The $50 per thousand referred to was a guess of a practical wood working manufacturer of what the price of white pine would be in 50 years. What "grandson" would have to pay per thousand under the Massachusetts plan would be less than $6, and this includes compound on the cost of land and planting to the time of harvest.

If the interest on the bonds for the purchase and reforestation of National Forests was met by direct appropriation from current revenue, the amount which "grandson" would have to pay as bonded indebtedness on the land and crop would be less than 70 cents per thousand, using white pine as the basis of calculation. Any "grandson" who would shy at paying 70 cents for timber worth from $25 to $50 would not be worthy of a progenitor like brother Sherman.

We realize now that we have not treated our woodlands properly, but is the crime as hideous as Mr. Sherman would lead us to believe? Our virgin forests which cost us nothing represented great wealth. We have simply changed the form of that wealth and everyone of us has benefited by the process. We have turned the forests into money and that wealth in one form or another will be handed down to the next generation. True, we have gone too fast and too far, and it will cost a great deal to restore our forests, but we are able to do so. Although we have been wasteful in the process of converting our timber into money, we still retain in one form or another the value received.

The sale of bonds is the most common method of meeting expenditures for projects which benefit others than the generation making the improvement. More than three-fourths of the States, about 200 cities, and probably thousands of counties and townships have resorted to this form of financing. It would be difficult to find a more favorable project for the use of bonds than growing trees, on which there is no depreciation, and which in fact cannot appreciably benefit the generation which plants them. Therefore, whether for Federal, State, or municipal government, this method of financing the restoration of our forests is perfectly legitimate, and the best thing about it is that the succeeding generations will have no burden to bear in connection with it, the profits from the timber produced meeting the bonded indebtedness and providing besides a fine heritage for "grandson."

As stated in the aritcle the big problem of forest restoration today is to get money in large quantities and get it quickly. With taxes as high as they are now this cannot be done through direct appropriations from current revenue, and to insist on doing it in that way is playing with the problem. It is not fair to ourselves or to our children. "Grandson" must have timber even if he has to pay full value for it, but he will not have it if he is to depend on our growing it through direct appropriations. Our timber shortage is an extremely serious problem and we must learn to think in big figures if we are to reach a satisfactory solution.

NOTES UPON THE PAPER INDUSTRY AND THE PULPWOOD SUPPLY[1]

By R. S. Kellogg

Secretary, News Print Service Bureau.

No other method of wood utilization approaches that of pulp and paper manufacture in the completeness with which the raw material is used and no one can set a limit to the number of articles of daily utility that it is possible to manufacture from pulp and paper. These articles will be manufactured in greater quantity and variety as our knowledge increases and as higher values of forest products lead to more scientific utilization of the timber supply.

Pulp and paper manufacturing is the one great industry using wood as a raw material in which there is much hope for the practice of forestry as a commercial undertaking upon privately owned land.

The production of large-size timber is too long an undertaking with too great hazards and too low a rate of return to attract the investor or to appeal to the practical sense of lumber manufacturers. On the other hand, the production of pulpwood of rapid growing species is a matter of much shorter time than the growing of sawtimber, and the amount of capital invested in a pulp and paper mill is so great as to require a long period of return.

Hence it is to the pulp and paper industry that professional foresters of the country turn most hopefully for the practical application of their principles.

The most superficial survey of the situation shows the urgent need of immediate and large scale efforts to provide a permanent supply of raw material for the basic industry of paper manufacture. We have become so accustomed to using paper extravagantly for a multitude of purposes that we do not stop to think that in most cases the piece of paper which we handle carelessly and cast aside is a forest product, and, what is more, a product of a rapidly disappearing type of forest.

To say that the production of wood pulp in the United States last year was 3,800,000 tons does not convey much to the ordinary reader,

[1] Resumé of an address delivered before the Washington Section of the Society of American Foresters, March 24, 1921.

but the problem begins to take on a more concrete aspect when we say also that more than 6,000,000 cords of wood—chiefly spruce and hemlock—was used to make this quantity of pulp.

The magnitude of the paper industry assumes further proportions when we enumerate the different classes of paper produced last year:

	Tons
Paper board	2,313,000
Newsprint	1,512,000
Book	1,104,000
Wrapping	832,000
Fine	389,000
Felts, etc.	367,000
Bag	212,000
Other grades	605,000
Total	7,334,000

In addition to this tremendous production of paper in the United States, imports (chiefly newsprint from Canada) amounted to 760,000 tons and exports to but 260,000 tons, making a visible supply in the United States in excess of 7,830,000 tons for the year, or 147 pounds per capita.

It is truly a paper age and even more truly a newspaper age. Newsprint consumption was 3 pounds per capita in 1880, 9 pounds in 1894, and 40 pounds in 1920. Last year was abnormal in many respects, yet there is no reason to think that the newsprint consumption in 1921 will be less than 35 pounds per capita.

It will be 217 years on the 24th of next month since the first newspaper was printed in America, and now our daily newspapers have a circulation in excess of 28,000,000 copies and there are more than 60 dailies between the Atlantic and Pacific whose circulation exceeds 100,000 copies, while some of them have several times this amount and one Sunday paper claims more than 1,000,000 circulation.

To most readers the daily newspaper is a transitory thing, hastily scanned and thrown aside, and the man who runs while he reads never stops to think what a wonderful co-ordination of service from lumberjack to newsboy is required to produce and give to him for two or three cents an up-to-the-minute resumé of world happenings in politics, industry, science, and education. Still less does the hasty reader realize that the newspaper which he holds in his hand is a 100 per cent product of the forests of North America, for unlike some other kinds of paper, wood fiber is the only constituent of newsprint paper. This is why

the forestry problem touches so intimately every man, woman, and child in the country, whether it be realized or not.

The average yearly pulpwood consumption in the United States is 5½ million cords, of which an average of 1,160,000 cords, or 21 per cent, is imported from Canada.

Our States of greatest pulpwood consumption are Maine, with an average of 1¼ million cords, of which 10 per cent is imported; New York, one million cords, of which one-third is imported; and Wisconsin, 800,000 cords, of which 30 per cent comes from outside the borders of the State.

The total amount of wood used for the manufacture of paper is not large compared with our consumption of forest products for other purposes, but because of the concentration of the industry in the Northeastern and Lake States and the large use of the three or four chief species of timber in these regions the problem of a future supply is particularly pressing.

The information at hand indicates that there may be in the Adirondack region of New York a total of 6,000,000 cords of privately owned stumpage of spruce, balsam, and hemlock, and there is in the same region about 9,000,000 cords of spruce, balsam, and hemlock stumpage on the State preserve, which at present is securely locked up against any use whatever.

If these estimates are correct, the total stand of pulpwood timber in the Adirondack region is equivalent to the rate of consumption of domestic pulpwood in the State for 25 years. However, the larger proportion of this total is on the State preserve, where all use is prohibited. Still further, these estimates make no allowance for the large amount of timber of these species annually cut for lumber.

The latest data compiled in Maine indicate that the total stand of spruce and balsam pulpwood is about 28,000,000 cords against which there is to be set an annual consumption of at least 1,000,000 cords of domestic pulpwood by the mills of that State.

The paper mills of the Lake States are using half a million cords of hemlock yearly, which will probably never be replaced.

It would seem that there will be comparatively little pulpwood of the present species left in the Northeastern States and Lake States 25 years hence, even if throughout that period the supply of Canadian wood continues in volume equal to the present, which is very doubtful.

But the Canadian supply is by no means inexhustible. While no complete forest inventory has been taken, fairly good general data have been compiled with the following result:

Estimated Spruce and Balsam In Eastern Canada—Cords.

Province	Entire stand	Available stand	Annual cut for pulp and lumber	Years supply available stand
Nova Scotia....	25,000,000	25,000,000	300,000	80
New Brunswick	36,000,000	26,000,000	1,000,000	26
Quebec	360,000,000	155,000,000	3,000,000	52
Ontario	250,000,000	100,000,000	1,200,000	83
Total........	671,000,000	306,000,000	5,500,000	56

It is a matter of common knowledge that the pulp and paper industry will increase in Eastern Canada for some time to come, which means that there will be a corresponding decrease in the length of the timber supply above calculated. On the other hand, increasing prices and demand will eventually bring into use much of the stand that is now classified as unavailable. On the whole, it may be conservatively said that even if the Eastern Canadian Provinces began now upon an adequate scale to put all their forest land upon a permanent producing basis they will not get forest crops any sooner than they will be required for the basic industries of pulp making and lumber.

The paper industry in the East is facing two alternatives if it is to be permanent: First, the utilization of other species, and, second, the growing of pulpwood—and it will have to accept both.

Notwithstanding the fact that 60 per cent of the area of the Northeastern States is better adapted to timber growth than any other purpose, the best we can hope for is a pretty severe stringency during the period between the comparative exhaustion of the present supply of pulpwood and the coming on of the new supply brought about by general forest protection and reforestation through the co-operation of National, State and private agencies.

The tremendous investments required in the development of great water powers, the construction of large mills, and the installation of exceedingly heavy and expensive machinery necessitate an operation of 40 years or more, in order to bring plant overhead down to a reasonable factor in production costs. This is the reason why the pulp

and paper manufacturer must take a long look ahead in providing for his raw material.

It is particularly encouraging to note, according to the Forest Service report in response to Senate Resolution 311, that fifteen forest owners hold some 5½ million acres, or nearly one-quarter of the forest area of Maine, New Hampshire, and Vermont, and that in addition to this the National Forests in the White Mountains exceeds 400,000 acres. This is an excellent basis for forestry operations.

The present consumption of pulpwood in these three States averages about 1,700,000 cords yearly. An annual growth of one-third of a cord of pulpwood on the acreage held by these fifteen owners would equal the present consumption. It is not unduly optimistic to expect an ultimate annual growth of pulpwood at this rate if conditions of forest protection and taxation become such as to make it a safe and profitable undertaking for corporations to carry on long-time operations of this sort in order to provide raw material for their mills.

In fact, it appears that pulpwood costs and values have now reached a point where the professional forester with practical experience can prove to the paper manufacturer that he can seriously think and plan for the growing of his future supply of timber.

We can, with some degree of confidence, make the following general assumptions for pulpwood forest growing over large areas:

1. A cost of $15 per acre for land and the stocking of it with young trees, either through planting or natural reproduction.
2. An annual protection charge of 5 cents per acre.
3. Six per cent compound interest on the investment.
4. We are justified in assuming that in the near future we are likely to have a cutting tax instead of an annual tax upon private land devoted permanently to forest growing, and we are setting a tax of this kind high enough when we make it 16 2/3 per cent upon the final yield, which is equivalent to an annual tax of 1 per cent upon actual value with a 6 per cent interest rate.
5. We are also justified in assuming, under good conditions, a yield of 20 cords per acre at the end of 40 years.

Applying the usual formulas of forest finance, we get $10 per cord at the cost of growing this pulpwood stumpage.

Any one who is at all familiar with timber matters in the Northeastern States will have no hesitancy in saying that pulpwood stumpage will be worth more than $10 per cord long before it can be grown.

This is the real basis for belief on the part of foresters that the time has now arrived when they can demonstrate to hard-headed business men that in forestry and not destructive logging lies the future of the great industry of paper making.

A FORESTRY ENABLING LAW

By M. S. Howard

Chief of Statistics, New York State Income Tax Bureau

The purpose of such a law is, by enabling farmers or others, who have waste time and waste land or either on their hands to get full value therefrom and at the same time, thereby to permit the United States to get started the large supply of timber it will urgently need in another fifty years. Of course a State might undertake this as well as the Federal Government.

The method here proposed by which this might be secured is as follows: For the Government to give a bond or preferably cash to anyone who would plant, in conformity with strict forestry regulations, an acre of land and who would give the Government a mortgage on that land during the period of the forestry crop. Let us assume that the labor expense of setting out an acre of land is $4, then when a landowner had set out or hired set out an acre of land, he would give the Government a mortgage on that land and receive a Government bond for $4 (or receive $4 in cash) payable at the end of 50 years with interest at, say, 4 per cent compounded annually.

If the Government's attitude is too penurious to give cash for the receipt of a mortgage on the reforested land, then there should be available the way of financing the reforestation of large areas without the Government having to raise a cent, by giving bonds as proposed above.

Of course the best alternative would be for the Government to pay cash, the second alternative is for the Government to give bonds that bear interest payable annually or semi-annually. Only in the case of the Government being too unwilling to adopt either of those alternatives is it suggested that the Government give bonds payable as to both principal and interest at the date of maturity of the bonds. If the bonds thus issued ran for a period longer than the period necessary for the growing of the crop then the Government would have the cash proceeds, from its mortgages on the forest plantations, already in hand when it had to pay the maturing bonds. Let us assume the forest crop

will be cut in 50 years, that it will cost $4 per acre to set out the trees and that one-fifth of the plantations will be destroyed before maturity, and also that 4 per cent payable yearly is the current rate of interest on Government bonds at the time they will be issued. For each acre set out then, the Government would issue a $34.59 bond payable in 55 years and would receive a mortgage on that acre for $43.23 payable when the Government gave its consent for the cutting of the crop. The $34.59 is $4 compounded annually at 4 per cent for 55 years (allowing the bond to run for 5 years longer than the growing of the crop) and the $43.23 is $5 (25 per cent more than the $4 to allow for 20 per cent of the plantations being destroyed before maturity) compounded annually at 4 per cent for 55 years. Of course, if the crop was cut earlier, say at the end of 50 years, the mortgage would be satisfied by the payment of $5 compounded annually for 50 years which would be only $35.54. Then the Government would invest this amount of $35.54 at 4 per cent which would make $43.23 in 5 years more.

It may be objected to that there would not be a sufficient market for bonds of such a deferred character as to the payment of the interest, in the United States. This objection probably would not be sustained by experience for these reasons. There are now a very large number of very wealthy people in the United States and many of them are primarily interested in maintaining the family fortune. Also many of them distrust the ability of their children to keep the property but prefer to tie it up until their grandchildren are mature men. Assuming such a man with $12,500,000; he could invest $2,500,000 in ordinary stocks and bonds paying current dividends and interest, and then invest the other $10,000,000 in the Government's 55-year 4 per cent bonds payable as to both principal and interest at the end of 55 years. At the end of that time his heirs would receive $86,463,669, and of course so far as security of investment is concerned he could get nothing better in the world. It would appear that the whole acreage that might be planted under the system of financing outlined could be taken care of through a market for such bonds among people of whom the above is an illustration.

Of course, the shorter term of the bond the better, but that feature of the bond would depend on the probable yield in thousand board feet at a given date as determined by the Government foresters who in determining this might allow a margin of 5 or 10 years in their

calculation of the years necessary to produce the crop. The rate of interest should not be such as to make the bond worth more than par but it should, if possible, be high enough so that whoever set out an acre, if he was a poor man and needed the money, would be able to dispose of the bond around par. Of course it would doubtless be impracticable to give such bonds unless at least 10, 25, or perhaps 50 acres or even more were set out in one plot as the plots would have to be inspected.

The bond the Government would give could be just the same as any other Government bonds; the bonds would not be secured or limited by any specific pledge of the real estate on which the trees were set out. Government bonds do not need any such additional security. If the Government so desired it could make the interest on the bonds payable currently, as annually or semi-annually; it would then in that case be currently advancing funds which it would recoup itself for, along with the interest on those funds, when the forest crop was cut. However, if the bonds were made payable as to both principal and interest only on the date of the maturity of the bond, then to the extent such bonds were issued the Government would not have to raise any funds, as the money would be available from the proceeds of the forest crop cut before the bonds became due. The bonds would probably change ownership before maturity the same as any other Government bonds, and would be presented for payment on date of maturity by the then owners the same as any other bonds.

Let us assume that 10,000 different plantations were made varying in size from 20 acres to 1,000 acres. The Government would have a mortgage on all those plantations. Some of them might be destroyed by insects or by fire or otherwise. But just as fire, accident, or life insurance rates are determined upon the various percentages of the insured people living to different ages and the risk of loss by fire or accident or death is spread over society accordingly, so here the Government having an interest in so large a number of scattered properties with scattered risks would nevertheless have the funds arising from the proceeds of the crops that were successful to meet the payment of the bonds issued for the planting of all the plots both those that were successful and those that might be destroyed.

If the plantations were numerous there would be some that it would be economical to destroy before the trees were mature, as in the case

of a discovery of valuable mineral resources and consequent growth of a city. Suppose such an event happened 10 years after a plantation was started and the owner desired to sell the land for building lots, then he could pay the Government the $5 per acre plus interest on that amount compounded annually at 4 per cent for 10 years and have his land released by the Government from the mortgage encumbering it. And the Government could invest the amount received at 4 per cent to be compounded annually and the proceeds therefrom in 45 more years would meet the payment of the principal and the interest on an amount of 55-year bonds which were issued the same year the particular plantation was made, which covered the cost of planting an equal number of acres.

This outline is based upon the belief that there are many farmers who have land that they consider practically valueless which they would be glad to see growing up to trees but who are deterred from incurring the expense of setting the trees out by the long time they believe they would have to wait before they got any return. Throughout New England and New York are farms that are entirely worn out or have one or more meadows completely played out or pastures grown up to such weeds as western oats or paint brush. With the forest gone, with the fox and squirrel and partridge that used to make the country so interesting, when the farmers were young, also gone, and with even the trout brooks now dry, many a valley is ranged by bare, bleak hills that furnish little interest for the rural people and less profit for those who try to farm those hills. Also there must be many lumber men and pulp men who would be glad to have their idle lands producing another crop but who do not consider themselves in a position to incur the initial expense. The reader can go into any backwoods community and find men who like such pursuits as hunting, fishing, picking berries, hunting ginseng, lumbering and other things that take them into the fields and woods but who will not come out into civilization to take up regular work where they will be restricted to regular hours under a boss. Yet they can get such work as they will do for only a small part of the year. If they could get a fair day's wages for setting out trees, perhaps on their own little played-out farms, or on the neighboring denuded or burned-over tracts of the lumber or pulp company, the potential value of their wasted labor power would be saved, they would be happy in seeing come back the

forests whose going they so hauntingly mourn, and the country would be getting back a great wealth that may be essential in some future national emergency.

A great part of our Eastern forests have been denuded by their owners cutting fuel and posts which they have sold for an amount equal to just a fair wage. The standing timber was in such cases valued merely as an opportunity to work for a fair wage when they had nothing else to do under circumstances which were agreeable for the reason they were not subordinate to someone else. Would they not be equally industrious in working under equally agreeable circumstances if they could get equal wages for restoring the forests? And especially if in place of having useless land they would be laying up for the next generation or two the excess value of the matured crop over the accumulated amount of the mortgage thereon.

With those men being independent while doing the work, the only thing they would have to follow as a guide would be the necessity of doing the work carefully enough to pass the test of the Government forester's inspection. If they did not own any land the lumber or pulp company or other owner of wild land could give them a permit to set out the trees while giving the Government a mortgage on the tract that was set out. The owner of the land would get the benefit of the low rate of interest procurable by the Government and would have all the profits in excess of the principal and compound interest on the mortgage. But of course it would be preferable to have all or some portion of the bonds interest-bearing if the Government would only do so.

The advantages of getting our forests restored this way over the other ways proposed are worth mentioning. The other ways that have been most discussed are (1) for the Government to buy the land and set out the trees, (2) for the private owners to set out the trees, and (3) for the private owners to reforest as far as they can be encouraged to do so and for the Government, Federal or State, to do the rest. The first method would involve the Government raising large sums either by taxes or borrowing. Also the funds would have to be large enough to purchase the land. The cost of the land plus the compound interest would be an amount the financing of which would be entirely unnecessary under the plan proposed in this paper.

If on the average the cost of the land would be at least equal to the cost of planting, then with a given outlay the Government could get at least two acres planted under the plan here proposed to only one if it had also to purchase the land.

With the Government having a mortgage on the land and the private individual owning it, in addition to the protection the Government should give the plantation there would be the immediate interest in the plantation which the owner would feel.

For the Government to go to buying wild lands extensively would force the price thereof up. The trouble with relying on private owners is that the great majority look upon the maturing of a forest crop as almost something that will occur in a distant geological age when there will be no one living in whom they are interested and also the initial expense which most of them feel they can not afford.

Just at present the Government has outstanding a large amount of bonds but those should decrease rapidly and the Government interest rate should soon be back to a normal rate of 3 to 3½ per cent, or at the most 4 per cent. (One of the most cardinal considerations in any reforestry plan is the great difference in ultimate cost between a low rate of interest and a high rate of interest. For example $10 at 3 per cent compounded annually makes $106.41 in 80 years, but at 6 per cent $10 in 80 years makes $1,057.96.) There should then be a good market for all the bonds the Government might issue under the plan proposed. If desirable the interest might be made alternative at a given rate payable annually or at a slightly higher rate payable at the maturity of the bonds.

It is assumed that the Government foresters would provide for many tracts being set out to white ash or other tool-handle stuff and fence-post material with bonds running for only 30 years or 40 years.

It is also assumed that the Government would furnish the seedlings free but if they preferred they could make a charge for seedlings at cost which would increase the mortgage and the bond accordingly.

Now let us assume if this opportunity was opened up to the people in the districts where there is much idle land and a large percentage of idle people, at least for a large part of the year, that is, of earning as much as the current wage by doing something at which they would be their own boss, that in a reasonable period of years 100,000,000 acres of land would be reforested. At the end of 50 years we could expect 2,500,000,000 M. of white pine. At only $10 per M. it would have paid our cost of the great war.

Is not the best way of trying to get our forests back along some such method as here outlined?

THE BURNING OF DEAD AND DOWN TREES AS A PRACTICAL PROTECTION MEASURE

By Roscoe B. Weaver

Forest Examiner, U. S. Forest Service

Standing dead trees play a very important part in the problem of forest protection. Their influence is twofold.

First. A large portion of lightning fires originate from dead snags.

Second. Fires are spread from burning snags standing near fire lines.

The eradication of this class of material from the forests will reduce the flammability of the forests and be an aid in the suppression of fires.

Although the experiment which forms the basis for this article was undertaken primarily for application to the forests of California, the writer believes that equally as good results can be attained in other forested regions.

With the rapid depletion of the country's timber supply, the need for more intensive protection for our timberlands is essential. The campaign now being waged against forest devastation and waste should be accompanied by as an intensive a campaign for the protection of the forests, both private and public. More than ever before, the timber owner is responsible to the people with reference to the manner in which he protects his timber from destruction.

Protection is divided into two principal divisions, *prevention* and *suppression*. Forest protection in its broad meaning endeavors to protect the forest, not alone from fire but from disease, insects, etc., which are likewise a menace to the development of the stand and often to its very existence. By protecting from fire, however, we are at the same time decreasing the amount of damage done by other destructive agencies.

The burning of brush and felling of snags on timber sale areas are methods of prevention. It is estimated in California that it costs the operator from $1.50 to $3 an acre to comply with the snag felling requirement in his timber sale contract. This is figured as an operating cost in the stumpage appraisals, which results in the reduction of the

stumpage price obtained for National Forest timber, so that the Forest Service in reality pays for the work. Timber sale areas, however, constitute but a small portion of the timber in the National Forests. There are important and valuable bodies of timber that should be protected by measures of prevention, but it is obvious that wholesale felling of snags is out of the question. Inadequate appropriations have prevented any extensive use of this method of fire prevention. Emergency funds are available for suppression of fires, but not for prevention. It therefore seems appropriate that some attention should be given to the prevention of fires. Some advocate burning over the forest as a preventive measure, but upon investigation is has been found that only in exceptional cases and on favorable areas is this method practicable or successful.

In California there are on the average 2.5 standing dead trees and snags, and at least an equal number of down trees and logs per acre. Five trees per acre, that are a danger to the health and very existence of the forest, constitute a menace that cannot be overlooked. If the forest can be cleared of this class of useless and detrimental material, the protection work would be simplified to a great extent; a decrease in inflammable material will have been accomplished; *prevention* will have come to the assistance of *suppression* and better *protection* will then be assured.

With the idea of working out a method of snag disposal that would be cheap enough to be usable, an experiment in burning down the standing dead trees was carried out during the latter part of October and forepart of November, 1920, on the Modoc National Forest in northeastern California. The experiment was extended after work started and applied to the down trees as well. These outnumbered the standing ones on the area where the work was done.

The burning was done in a pure stand of Western Yellow Pine, under east side conditions, averaging about 15,000 feet per acre. The land was level with very little brush, but the area contained a very good stand of reproduction, especially in the open areas and in the neighborhood of dead trees and windfalls. Rain had fallen a few days before, and during the experiment the nights were cold and the days moderately warm. Everything was favorable for the work, but conditions were not abnormal for the region at that time of the year.

METHOD

The work was done by a crew of four men—the forest supervisor, two rangers, and the writer—all regular employees of the Forest Service and very much interested in securing favorable results, but doing no more than could reasonably be expected of others less interested.

The tools used were a small ax and a brush burning torch. Each man took a strip of convenient width, burning up to the man on his right or left, depending upon the location of the one who was regulating the direction of the strip. Usually a small quantity of pitch wood or splinters was carried to assist in starting the fire. In a majority of the trees the sapwood near the ground was rotten and punky, so that with but little chopping a hole could be made in which the fire could be started. In trees that were solid a hole sufficiently deep was chopped in the wood as near the ground as possible, or in a pitchy portion, where the fire would take hold. A few pieces of bark and wood were all that were ordinarily needed to start the tree burning. In cases of the down trees the fire was started in the roots, if the tree had been uprooted. If broken off, both the stump and tree were fired.

An area of 2,000 acres was covered in eleven days' work. During this period 4,600 standing and down trees were set on fire. Of this number 1,695 were standing and 2,905 were down trees. Not less than 80 per cent of the standing trees burned to such an extent that they fell a few hours after being fired. A very considerable per cent burned up entirely after falling. A greater part of the down trees were consumed, so that a much cleaner area existed, with no damage having been done to the living trees or reproduction. The fires would not run, so that any attempt to lightburn would have been useless and without the success accomplished by burning the individual trees.

Those trees that had recently died would not burn well and in but few cases was an attempt made to ignite them. By the use of a two-inch auger such trees can be successfully felled and burned. Two holes are bored into the tree, one perpendicular to the trunk of the tree, extending a little past the center, if possible. The other hole is started above the first and bored at an angle to and intersecting it near the center of the tree. Lighted pitch is then dropped into the

upper hole. Pracically every tree will burn down if ignited in this manner. It takes an average of ten minutes to set fire to a tree by this method. Only a few trees were burned by the use of the auger, the entire operation being based on the other procedure. The two methods combined can be used to advantage in actual practice. One man on horseback would follow up the burning crews and use the auger on such trees that did not burn down, and in this way clean up an area very successfully.

A majority of the trees that did not fall were so burned and charred over that they will not catch fire from *any* surface fire and thereby be the means of spreading a fire. This was proved many times in attempts to burn old charred snags and trees. More labor and more fuel was required to get them started, and in many cases the fuel would burn up but the tree would not ignite. If a fire could be started in the roots under the tree there would be more chance of burning these old charred snags. The auger method, however, would make short work of them.

WORK ACCOMPLISHED DURING THE EXPERIMENT

Area covered	2,000 acres
Trees set on fire	4,600
Trees burned per man per day	115
Average number burned per acre	2.3
Total volume of trees ignited	5,530,000 feet b. m.
Average volume per acre burned	2,760 feet b. m.
Average time to fire a tree	4.1 minutes

COSTS

Labor	$218.78
Subsistence	30.75
Automobile travel (416 miles at 7 cents)	29.12
Kerosene and matches	2.30
Total	$280.95
Cost per tree	.06
Cost per acre	.14

The above costs are certainly far below those obtained in felling with a saw. In 1917 D. C. Birch conducted a study of the costs of felling snags on timber sales on the Plumas National Forest in California. His investigations showed an average felling cost of 21 cents per tree of 30 inches diameter, based on 140 trees of mixed conifers. For yellow pine having an average diameter of 23.7 inches it cost

$0.166 per tree, or 50 cents per acre, figuring three trees per acre. These costs would be much higher now than in 1917. It is presumed from Mr. Birch's data that subsistence was not figured in his costs, which if true would raise his figures materially.[1]

The present cost figured on the basis of $1.50 to $3 per acre with an average of 2.5 trees per acre would give a felling cost of from 60 cents to $1.20 per snag. The cost obtained in the Modoc experiment was for both standing and down trees, but on the average it took longer to fire the down trees since in the majority of cases it was necessary to start at least two fires for each down tree. If the burning had been confined to the standing trees only, more acreage would have been covered and the cost per acre lowered. Consequently, it is believed that the cost of 14 cents per acre would be representative for the type and topography. The cost would naturally be higher for more rugged country and for fir and mixed types.

The burning cost of 14 cents per acre against a minimum charge of $1.50 for felling standing snags would warrant the use of it in timber sale practice, supplemented by the use of the auger, as required.

APPLICATION OF THE BURNING METHOD

1. As indicated above this method can be used on timber sales. Instead of figuring on an operating cost in stumpage appraisals of $1.50 to $3 per acre for felling snags, the Forest Service can burn not only the standing dead trees but dispose of windfalls, unmerchantable trees and logs left after logging, for much less than it now costs to saw down the standing trees. A higher stumpage rate could be obtained for the timber and the timber sale area would be cleaner, more sanitary, and have a lower fire hazzard. It would result in a combined preventive measure against fire, insects, and disease.

2. Areas of high fire hazard, such as occur along railroad rights of way, highways, and forests visited by campers and hunters, could be made less dangerous by the disposal of dead trees by burning.

3. Snags and down timber can be eliminated along artificial and natural fire barriers for a width of from 400 to 600 feet and used for suppression should occasion arise.

4. Lines of natural fire defense such as roads, ridges, streams, etc., can be cleared of snags and windfalls and made the stronger thereby.

[1] JOURNAL OF FORESTRY, December, 1918.

5. The forests in and around recreational areas can be made safer and more sightly by the elimination of dead trees.

6. One of the regular jobs that the forest ranger has to do is to remove fallen trees from across roads and trails. Instead of having to pack an unwieldly saw, ax, and wedges for miles on horseback or by packhorse, he can carry an auger with him. Whenever a tree is encountered across the trail all he would have to do would be to bore two sets of two holes each at each end of the desired length, set fire to them and go on to others. Upon his return the road or trail would be clear or merely partially burned logs to be rolled out of the way. Dead trees standing along the trail or road can be burned at the same time, thus removing trees that may fall in the future.

It is needless to say that all of the activities mentioned above should only be done at favorable times, when the fire danger is absent.

The apparent success of this experiment opens up prospects which indicate that greater possibilities may be realized by its extension into a very important work. The application of burning as a snag disposal measure does not appear to confine itself to the coniferous forests of the West, for the April, 1918, number of the JOURNAL OF FORESTRY (page 479) contains an account of an experiment in burning old hardwood stubs in New York with the aid of gasoline. Birch, beech, and maple were successfully burned.

Experiments in other types and with other species, carried on in more difficult topography are necessary to justify the general use of the principle. The method offers promise of success, and it is to be hoped that large scale experiments will develop it.

CONTROLLING INSECTS IN LOGS BY EXPOSURE TO DIRECT SUNLIGHT

By S. A. Graham

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The protection of logs, left in the woods over the summer season, from the attack of wood-destroying insects is one of the difficult problems facing the forest entomologist. Several suggestions for the control of the pests concerned have been made from time to time and have proved more or less successful. The most effective method recommended, that of immersion of the logs in water, is a matter of common practice in handling coniferous species. The loss through water logging will not permit this treatment for most hardwoods and, since it is not always possible to get even the conifers into water, we must often resort to other control measures or stand very material losses. Barking the logs and shading with brush have been recommended and have been used in practice to a limited extent.

Exposing the logs to direct sunlight is the latest method suggested for controlling these insects. A brief article by Craighead [1] describing the effects of solar radiation upon logs has appeared during the past year. Working with ash logs in several localities in the South, he found that the upper side of logs lying in full sunlight often reached temperatures above the fatal point for insects. On the basis of these findings he recommends weekly turning to protect logs from wood borers. He observed temperatures under the bark of logs which exceeded air temperature by as much as 60° (F.), depending upon the locality, condition of the sky, and angle of the sun's rays.

From work being conducted in Minnesota it appears that there are a number of other important factors influencing the subcortical temperature of logs which Craighead has failed to mention, such as color, structure, thickness and surface of the bark, air currents, evaporation from the surface layers of the bark, and proximity to other absorbing or radiating surfaces. It therefore seems desirable to publish this

[1] F. C. Craighead. Direct Sunlight as a Factor in Forest Insect Control. Proc. of the Ent. Soc. of Washington, Vol. 22, pp. 106-108. 1920.

preliminary note to call this matter to the attention of foresters. A more extended paper, including tables and graphs, will appear in the 18th Report of the Minnesota State Entomologist.

It has been found that in bright sunlight the temperature under the bark of some moderately thin-barked logs often passes above a point fatal to the insect inhabitants of the logs. For example, on July 3, 1920, a white pine log with rough bark 5 mm. thick reached a temperature of 60° C. at 1 p.m., which was 20° C. above air temperature in the sun as registered by a white bulb thermometer. An excess of log temperature over air temperature of from 15° C. to 20° C. was common on bright days throughout the summer. Thus the subcortical temperature in white pine frequently exceeded 48° C., which is the fatal temperature for most insects.

On the other hand, not all logs reached this fatal temperature even on the brightest days. Norway pine logs with bark 10 mm. thick never exceeded 46° C. at any time during the summer. Even the Norway pine logs with bark only 2 mm. thick did not exceed 48° C. at any time. From this it is apparent that the control of insects in logs by solar radiation is not applicable in all cases. It is therefore essential that the factors limiting its application be understood if the method is to be intelligently applied.

Briefly these factors may be summarized as follows:

1. To raise the temperature in logs above the fatal point for insects it is necessary to have bright sunlight. Solar intensity depends upon the clearness of the atmosphere and the altitude of the sun.

2. The position of the log with reference to the sun's rays influences the amount of heat absorbed by the log since the rate of absorption is inversely proportional to the angle of incidence of the sun's rays upon the log. The position also determines the proportion of the log which will be raised to a high temperature. Only a narrow strip on the south side of a log lying east and west will be exposed to the direct sunlight while on a bright day the sun passing from east to west will strike directly and heat a much larger proportion of the log lying north and south. The direction in which the log is lying therefore determines how far it should be turned each time.

3. The bark characteristics which affect log temperatures are: (*a*) Color; dark bark absorbs heat much more rapidly than light colored bark. (*b*) Surface; rough bark provides a larger absorbing and radi-

ating surface than smooth bark and gives a higher temperature provided the angle of incidence is not great. (*c*) Structure; scaly bark is a better non-conductor than bark of a uniform close texture and therefore tends to hold down a subcortical temperature. (*d*) Thickness; this tends to increase insulation.

4. Air movement tends to increase radiation from the log and therefore tends to reduce the temperature beneath the bark.

5. Evaporation of water from the surface layers of the bark which often takes place in early morning, or following a rain, tends to reduce the log temperature.

6. Close proximity to other radiating or absorbing surfaces tends to stabilize the temperature beneath the bark.

7. Conduction of heat around a log is slow but varies with different species. This results in the concentration of heat in comparatively limited areas.

THE PERSONAL EQUATION IN BRUSH DISPOSAL

By K. E. Kimball

Men love to leave the consideration of important questions to bicker about details of execution. This is sometimes a clever means of avoiding dissentions in conventions. Again it is a smoke screen to hide the importance of the real issue. Take the matter of a National Forest policy. It would seem that far too much has been said about the details of its execution and particularly about slash disposal.

This slash disposal matter has been held up as a regular "bogie man." It has been made to appear that a policy of forest conservation and reforestation must stand or fall by the adoption or rejection of this detail. Absurd statements have been made concerning the cost of brush disposal and equally absurd statements as to its necessity. No one who has seen U. S. Forest Service systems of brush disposal in operation will be mislead regarding costs, and no one who has had to fight forest fires in a logged-over region has any weak-kneed ideas as to the desirability of slash removal. However, this is not what I started out to talk about. I am going to take the need for brush disposal for granted and say a little out of my own experience about costs, and particularly about an element of costs which seems to have escaped general comment.

The White Mountain National Forest has some mighty bad slash areas and the region has suffered heavily from forest fires. The timber-sale contracts now in force on the Forest all contain a brush-disposal clause. The writer has been a close observer of the attempts to enforce these clauses and of the attempts at evasion. It goes without saying that the clauses have been enforced, but right here is where the thing I want to talk about comes in. Call it the personal equation, the personal factor, the human element, or what you will; I believe it is the starting point from which brush disposal and its costs should be examined.

Probably illustrations will best present the point. Last winter the observations to ascertain the actual cost of brush disposal under operating conditions on the National Forest were continued. Observers were sent to operations under Forest Service supervision and notes taken over an extended period. One observer was sent to a sale that

had been under way for four years under the same management. One would suppose that any lumberman would have become convinced by that time that the brush disposal clauses in his contract had teeth in them. Also one would suppose that he would have worked out an efficient method of burning softwood brush and lopping hardwood tops, especially when he had had the advice and example of the entire Forest personnel for the previous years.

This contractor hadn't done so and probably never will. He tried for two years to evade the requirements of his contract and then yielding in fact, he never did grant in spirit the necessity or the desirability of brush disposal. Every time a forest officer spent the night at his camp he thrashed the whole matter over again and would end up by declaring brush disposal an expensive and a useless nuisance. All this in the presence of the men who had the actual work to do. Also these men were paid by the day.

The observer found that crews from this camp made the poorest showing of any on the operation. The man who did the burning for one crew was nearly 65 years old, the idea being that any one could burn brush and the less money he would work for the better. This man was continually getting behind the choppers and piles of spruce slash were frequently snowed under. The cost of burning such slash is materially more than for fresh slash. It is pertinent here to say that the observer is of the opinion that one good live man can easily burn the slash for two crews of two or three men each when the operation is in a mixed hardwoods and spruce stand as in this case. It is, of course, essential that there be co-operation between the choppers and the burner.

Other crews were working on the same area and under the same conditions, except that they were paid by the thousand feet of timber cut. All crews were supposed to load the teams hauling their logs. Two French Canadians composed a certain crew. They had accepted the idea that the slash must be taken care of and they had worked out methods which were efficient and the results acceptable. They were average men and were paid by the thousand. Besides fitting the timber and taking care of the slash, they had to load a four-horse drag team twice a day, the loads averaging better than a thousand feet board measure per load; yet these men were always ahead of their team. The observed costs for this crew ran as low as 50 cents per thousand for burning softwood brush and 70 cents per thousand for lopping

hardwood tops. Also they were able to fit timber, including the costs of brush disposal, as low as $3.50 per thousand when the rate of pay was $7 per thousand. Their average costs over an extended period were barely 50 per cent in excess of the above. Other crews from the same camp made good records and their average costs for the period covered by the observations were but little higher than those of the French Canadian crew.

The crews from the first camp mentioned had costs of over $2 per thousand for both burning and lopping and the highest costs recorded were higher still. I want to emphasize that this difference was not due to any difference in skill between the crews concerned, or of quality or kind of timber, or of conditions under which the crews worked. The difference lay in the attitude of the crews toward their work, particularly the brush disposal. As regards one particular crew, it was observed on several days that they spent more time (man minutes) in loading their team than in brush disposal and it was further observed on more than one day that this crew did not cut timber enough to pay their wages. The contractor who hired these men considered them his best crew and laid all the extra costs to brush disposal. Just what the actual costs of the different branches of the operation were he never took the trouble to find out, and nothing that the observer felt free to say could convince him that his methods and his guesses were not correct. Right here it may be well to point out that an attitude such as this contractor constantly showed toward the regulations under which he had agreed to work, will always react on the crew to the detriment of the work aside from brush disposal, since it undermines discipline and gives the crew an alibi if they are inclined to shirk.

The observer was on this job an extended time. He has been intimately acquainted with this operation from its inception. With the data on paper and the averages worked out, there was not nor can not be any doubt as to which crew was the most efficient. Allowing that each crew had an equal opportunity, as is a fact, the thing to be determined is why one crew or set of crews was more efficient than the others. The following is believed to be the reason:

In the camp of the least efficient crews the men were paid by the day and heard the requirements of the Forest Service depreciated practically continuously. In the other camp the men worked mostly by the thousand and little was said about brush disposal. The men agreed that it was a bother, possibly a good thing, but something that must

be done anyhow. The crews from the first camp were all among the high-cost crews. The crews from the second camp were all among the low-cost crews. The difference between the average high cost and the average low cost was considerable. It may be argued that since these different sets of crews were paid in a different manner, the difference in costs could be traced to this fact instead of to their different attitude toward their work. This is a valid argument and doubtless had an important influence on the result. However, it is desired to point out that since paying by the thousand was bound to promote efficiency, the crew so paid soon found out that brush could be taken care of at a reasonable figure, thus removing the argument that brush disposal was an imposition on the logger. Their minds thus cleared or neutralized were open to the reasonableness of the procedure, and the total psychological reaction was to make the men take pride in their work and to do it in a manner that would pass inspection. Moreover, there is a mass of data showing that men paid by the day have done satisfactory work when convinced of its necessity, and this at a reasonable cost. Also there are records to show that men paid by the thousand have not worked either efficiently or satisfactorily, according to Forest Service standards, when they believed that brush disposal was unwarranted or could be evaded.

One can draw his own conclusions, but if one had followed this sale and these men for four years he would conclude, just as the observer did, that it makes all the difference between efficiency and moderate costs and inefficiency and high costs whether the men doing the work of brush disposal have their hearts in the work or not. Nor is this example an exaggeration of the average contractor's attitude, except in the matter of stubbornness. What has been said of the efficiency of the crews, of costs, of conditions, and of results is not exceptional at all but matters of every day experience with forest officers in charge of timber sales on the White Mountain National Forest.

Let those who oppose brush disposal from the standpoint of high costs give this matter of the personal equation a serious thought. Let those who have tried brush disposal, or think they have, ask themselves whether they first condemned the idea before the men who had the actual work to do and whether, aside from going at the matter with an open mind, they gave their men any incentive to do the work cheaply or an efficient system to work under. To the men who have met these problems first hand and have secured efficient methods and low costs, much of the printed matter on the subject appears hypercritical. To lumbermen, big and little, these men say "get next" and then hunt brush disposal costs open minded and efficiently. The thing can be done because it has been done.

CHOICE OF SPECIES FOR USE IN PLANTATIONS OF PULP AND PAPER COMPANIES IN THE NORTH[1]

By H. B. Shepard, M. F.

Forester, Eastern Manufacturing Co., Bangor, Maine

In making definite plans for the establishment of commercial pulpwood plantations the question of the choice of the species to be planted is one of the most important. Pulp and paper companies of necessity depart at once from economic forestry in so far as the greatest financial yield from the ground is concerned and go immediately into specialized forestry, the object of which is to produce pulpwood species. In other words, while perhaps a purely theoretical forester would recommend certain species for certain sites because of the greater possible financial return, the forester managing pulpwood lands must produce a species, if at all possible, primarily adapted to pulp manufacture. The problem, therefore, is to produce on a given area of land, the maximum possible yield of a species that will meet the needs of the pulp mill for which the lands are supposed to furnish raw material.

Throughout the North Woods two principal kinds of pulp are manufactured, namely, ground wood and sulphite. There is also, to some extent an industry manufacturing sulphate pulp and soda pulp, but these two processes are of minor importance compared with the ground wood and sulphite processes and will not be considered in this report. If the pulp and paper industry is to be kept alive and commercially important in the north woods it will be through the ground wood and sulphite processes.

Furthermore, wood which will produce good sulphite economically is also adapted to ground wood and conversely, so the two can be considered under one head and discussed together.

It is not the purpose of this paper to call attention to the dwindling supply of naturally grown pulpwood and the need for early steps toward artificial replacement, further than to state that already several pulp and paper companies are committed to more or less extensive planting programs and are merely endeavoring to work out details of procedure.

[1] Read before the New England Section, Society of American Foresters, March 12, 1921.

The writer, representing one of the larger Maine concerns, is working up to a planting program which by 1924 will embody the planting of 2,000 acres of burned land annually. As previously stated, the question of the choice of species to be used has occupied a great deal of attention but seems now to have been settled on through quite definite proof.

REQUIREMENTS OF SPECIES FOR PLANTING

The chief factors entering into the decision of the question of what species to use are:

1. Adaptability of wood to pulp manufacture.
2. Adaptability of species to existing growing conditions.
3. Rate of growth.
4. Ease of handling in nursery and field.
5. Resistance to disease and other natural enemies.
6. Availability of adequate seed supply.

ADAPTABILITY TO PULP MANUFACTURE

Compliance with the first requirement indicates the use of some species of spruce. No other genus has yet been discovered in the world which equals spruce as a pulp producing wood, and it is of course as a consequence of this fact that the pulp industry has established itself largely within the commercial range of the spruces.

Three chief species of spruce are now mainly utilized for pulp manufacture in America, white or cat spruce (*Picea canadensis*); red or yellow spruce (*Picea rubens*); and black or swamp spruce (*Picea mariana*). Through New England and New York the principal pulp species is the red spruce, supplemented by white spruce, black spruce, fir balsam, and to some extent, hemlock. Through Canada the principal species is white spruce, supplemented by the other species mentioned. Red spruce, however, occurs in Canada, only in southeastern Quebec and the Maritime Provinces.

Black spruce has proved to be an excellent pulp species, giving a large yield of excellent fiber per cord, and is much in demand by pulp mill men, though the comparitively limited amount in New England makes it commercially unimportant. There is in Maine a prejudice on the part of pulp mill men against the white spruce, though it is utilized along with the red and black as it happens to come. Commercially it

is even less important than the black spruce because of its limited occurrence. During the period of exploitation of the present natural forest, red spruce will undoubtedly continue to comprise the bulk of the pulpwood consumed in New England, and it is to the pulping characteristics of this wood that the pulp industry has been adapted.

Concerning the popular prejudice against white spruce, the basis for which is the claim of lower yields and weaker fiber, it may be well to quote the bulletin [2] recently published by the Forest Products Laboratory as follows: "White spruce (*Picea canadensis*)—Sulphite pulp—Yield 1,030 pounds (per 100 cubic feet solid wood). Eastily bleached, easily pulped, excellent strength, excellent color. Possible uses: White spruce is considered the standard sulphite pulpwood and is used for news, wrapping, high grade printings, etc."

Without quoting further it is sufficient to say that they also speak highly of white spruce for sulphate and ground wood pulp. It seems probable that in view of the fact that white spruce already constitutes the source of a great deal of the pulp now being produced in Canada and parts of the United States other than New England, and that it is spoken of so highly by the investigation at the Forest Products Laboratory, the prejudice in New England is not well founded. Undoubtedly under present methods, adapted to cooking red and black spruce, the white spruce does not show up so well, but it seems extremely likely that if white spruce formed the bulk of the wood the cook would be adapted to it and satisfactory results obtained.

I have so far made no mention of Norway spruce, but since it has been demonstrated that this species will thrive at least to some extent in the North Woods it should be given consideration. That the wood is adapted to the manufacture of pulp of all grades is well known. In Europe it is the standard pulpwood species and produces the very high grade pulps manufactured there.

ADAPTABILITY TO GROWTH CONDITIONS

Adaptability to existing growing conditions, the second requirement is sufficiently well met by all the species of spruce mentioned with the exception of the black spruce. The Norway spruce will, it is believed, adapt itself more or less well to practically all conditions, but the black

[2] American Pulpwoods: The Suitability of Various Species of American Woods for Pulp and Paper Production. Otto Kress, S. D. Wells, Vance P. Edwards.

spruce is a swamp tree primarily and will not do well on the higher sites. Either the red or white spruce grows on practically all sites except the very wet or very mountainous. Even here they occur but not with sufficient thrift to be of commercial importance. In the natural forest the white spruce occurs largely on moist sites along the stream bottoms, but where artificial disturbance, such as blow-down, fire, or cutting occurs it seeds in abundantly and more than holds its own with the red spruce in the restocking stand.

As far as adaptability is concerned, therefore, we can only definitely rule out the black spruce. We have not had sufficient opportunity to observe the Norway but the indications are that as far as adaptation is concerned it will meet the requirements.

RATE OF GROWTH

The third requirement, that of rate of growth, is still in the process of study. Without prolonging this paper to the extent of giving comparative figures, it has been fairly definitely proved, that as far as Maine is concerned at least, the black spruce is the slowest growing, the red spruce next, and the white spruce the fastest on the sites best adapted to the individual species. As white and red spruce seem equally well adapted to all sites in the replacement forest, it is unlikely if there are any sites of commercial importance where red spruce would average to show more rapid growth than white.

The accompanying table shows the results of a stem analysis growth study on white spruce in replacement stands in northern Maine, based on measurements of close to 200 trees. These figures indicate a rapid average growth for the species, quite sufficient for the purposes of pulpwood plantations. How this compares with the results Norway spruce might show I do not know, but my observation on a plantation now in its sixth year indicates that the white spruce makes a much faster start. One thousand white spruce planted in 1916 had in the summer of 1920 an average height of about twice that of 1,000 Norway spruce planted at the same time on the same site.

HANDLING IN NURSERY AND FIELD

Testimony of various experienced nurserymen indicates that Norway spruce is much the best nursery tree, being easiest to cultivate and handle without loss. In this respect none of the other species is so good, though both red and white spruce can be economically produced

in commercial quantities by proper methods. Loss in the field after planting depends so much on the care the individual tree receives in planting and the particular conditions surrounding it that it is very hard to make comparisons of the handling qualities of different species. Our experience so far indicates, however, that none of the three species, Norway, red, or white, possesses any particular advantage in this respect over the others. We have observed, however, quite a lot of damage to the young Norway spruces from nipping off of the new shoots, probably by rabbits. I believe this is a common phenomenon with exotics. The animals seem to recognize it as something new and have to give it a try to see if it isn't something good.

RESISTANCE TO DISEASE, ETC.

In respect to resistance to disease and natural enemies we have not a great deal of information, and the question admits of a tremendous amount of study. Suffice it to say that the spruce bud worm is the enemy most to be feared of which we know anything today. How the Norway spruce resists this pest we have no way of knowing but we do know that the red spruce resists it very badly. Immense quantities of red spruce have been killed by the bud-worm in Maine during the past ten years. The white spruce, on the contrary, while not wholly immune from attack, seems to be entirely immune from death or permanent injury from this cause. The writer has yet to see a white spruce killed or badly damaged by the bud-worm, even in the midst of his worst havoc on red spruce and fir.

SEED SUPPLY

The last requirement, that of seed supply, is unquestionably best met by the white spruce. It does not seed more freely, so far as we know, than the red spruce, but the seed is much easier to extract. Norway spruce seed can, of course, be imported from Europe or purchased in this country, but the writer much prefers to use seed of known origin which is difficult in the case of seed purchased in the market. The experience gained by the writer this past year in collecting white spruce seed indicates that it can be done easily and economically from standing trees and there is every reason to believe no shortage of seed will ever be felt as far as our own needs are concerned, collecting in the better seed years from trees on our own land.

White Spruce Growth Table for Even Aged Stands (Old Field Growth in Maine)

Age	D.b.h., inches	Total height, feet	Merchantable height, feet	Total volume, cubic feet	Merchantable volume, cubic feet	Mean annual growth, cubic feet	Mean annual growth, per cent	Periodic annual growth, cubic feet	Periodic annual growth, per cent
10	1.2	7.1		0.2		0.020	10.0	0.02	
15	2.6	12.8		0.7		0.046	6.6	0.07	
20	4.3	20.2		1.5		0.075	5.0	0.13	15.3
25	5.6	27.6	12	2.7	2.0	0.108	4.0	0.20	11.8
30	6.6	34.5	17	4.2	3.9	0.130	3.1	0.27	9.5
35	7.3	40.2	23	6.2	5.8	0.166	2.7	0.35	7.9
40	7.8	45.2	28	8.3	7.7	0.192	2.3	0.41	6.5
45	8.4	49.6	34	10.4	9.7	0.215	2.1	0.42	5.2
50	8.9	53.4	38	12.5	11.6	0.232	1.9	0.42	4.0
55	9.3	56.8	42	14.6	13.5	0.245	1.7	0.42	3.5
60	9.8	59.7	45	16.7	15.5	0.258	1.5	0.42	2.9
65	10.3	62.2	48	18.8	17.4	0.267	1.4	0.42	2.5
70	10.9	64.3	52	20.8	19.3	0.276	1.3	0.41	2.2

NOTE.—Based on measurement of 199 trees (curved). Periodic annual growth (cubic feet and per cent) is for 10-year periods, i.e., 10 to 20; 15 to 25, etc., based on total volumes.

CONCLUSIONS

We have considered, therefore, as the possible choices of species for artificial restocking, four species of spruce—black, red, white, and Norway. The black we eliminate at once because of its slow growth and poor adaptability to all except special sites. I think I have shown that the red spruce is not so deserving of consideration as the other two because, first, it grows more slowly than either of them; second, is very susceptible to the bud-worm, and third, does not admit of so economical seed collection.

This leaves us, then, two species to consider—white and Norway. The Norway is an exotic species and very little is known of its real possibilities. In so far as its establishment and early growth in the plantation is concerned, it is inferior to white spruce. That it will produce excellent pulpwood is a certainty but its real rate of growth under northern conditions, its resistance to enemies, particularly the bud-worm, and its seed supply are unknown quantities. The seed supply is abundant, to be sure, but not certain, as to quality and origin.

All considerations indicate strongly, for the present at least, the use of white spruce. This is a native species of known characteristics, is a rapid grower, easily adaptable to practically all conditions, exceptionally resistant to the serious known enemies, and affording an easy seed supply. It is without question, therefore, until more is known at least, advisable to concentrate efforts in planting on the white spruce which gives more than reasonable promise of success, rather than to experiment on any large scale with the others. Norway spruce may make good but until it does we should by all means stick to the known quantity. When white spruce forms the bulk of the pulpwood coming to any one mill the cook will surely be adapted to it and satisfactory pulp produced.

WHERE FORESTRY AND RECREATION MEET

I

From an Administrative Standpoint

By C. J. Stahl

If I were writing a story, I should keep you in the dark until the final paragraph had been reached. But since that is not the purpose of this paper, it is just as well to announce my convictions at the outset.

Forestry and recreation do not meet in the commonest usage of the verb. They are co-existent.

The earliest use of forests by man was probably that of a domicile. Later it became a place of refuge. As civilization advanced, they were chosen as pleasure grounds and their popularity as such seems to have increased with the march of time.

One of the most cherished prerogatives of the King of England, at the time when his power was at the highest, was that of converting any portion of the country into a forest in which he might enjoy the pleasures of the chase. At common law, it appears to have been the right of the King to make a forest where he pleased, so long as certain legal formalities were observed. The King having a continual care for the preservation of the realm and the peace and quiet of his subjects, it was regarded as his privilege to have his place of recreation wherever he chose.

It was much the same in France and Germany. Until fairly recently, those employed in the European forests were expected to perform duties in connection with the chase, and hunting usually had superior claims to forestry, even after scientific management had been initiated. Stock was permitted to range within the forest; but the main incentive for the regulation of forest use, on the part of the King, was the interests of the chase.

And while the characteristically American habit of profit-making seems now to have become the principal and controlling element in the management of both public and private forests, a change in the program is due. Visitors are coming to the forests, solely for pleasure and recreation, by the millions, and in the semi-arid regions every little

grove is eagerly sought. Often a very ordinary clump of cottonwoods along a stream is a popular picnic ground. With better roads and automobile transportation, the more extensive and attractive timbered lands are now accessible.

The direct and present return from forests naturally commands the interest of the owner and the public, but it doesn't necessarily follow that the indirect value is the least. On the contrary, it probably exceeds the direct utility. The influence which forests have upon climate and streamflow is recognized. Why not their influence upon public health, morals, and education? No one will attempt to argue against the beneficial effect of a visit to the forests. The scoutmaster makes a big point of getting his troop of boys into the forest for education, inspiration, and the improvement of their health. The business man goes there, not merely for a good time, but for a renewal of the energy and nervous force expended by him in carrying on his share of the world's business. The mothers and children go there for restoration of health, patience, and strength needed by them in the performance of their duties, and the development of the youngsters into good citizens.

At a recent conference of National Forest men, a paper was read, in which it was shown, by calculation from figures obtained by fairly correct data resulting from statistics of sheep grazed on the Cochetopa National Forest, that due to mismanagement of sheep grazed upon the National Forests (such as improper wintering, poor selection of breeding stock, marketing, etc.), there resulted an annual preventable loss in production of 120,000,000 pounds, expressed in 60-pound lambs, 2,000,000 muttons.

Although figures are not available to show the loss of human life, energy and accomplishment, can any deny that it is any the less real? Why is not the indirect recreational value of forests just as truly economic as the indirect influence upon streamflow regulation? Statistics for the United States Army for 1918 show a mean strength of 2,518,499 men with a total loss of 40,692,302 man days due to disease. The ratio of ineffectives per 1,000 men, including all members of the Army, was 44, and this in an organization where special facilities were available and special effort made to keep men in condition. Can you imagine what the ratio of non-effective time would be if applied to the nation as a whole, where advantage is not taken of opportunity

to improve and protect health? Many people give no thought to taking a vacation, as if such waste of human vitality, such failure to restore the normal drain or strength could ever be wise or creditable.

I was a listener at a recent conversation between two physicians, in which the belief was expressed that as a result of the public taking more exercise and pleasure in the open, and especially the mountains, the medical profession was becoming less attractive to doctors of general practice and that the solution was going to be dependence on ability to have arrangements with a few families to look after their health for an annual consideration. Both agreed that the general health of the public was improving to such an extent that there was no field for the common practitioner.

Recreation is without doubt a by-product, but a very essential one to the nation. The time is coming when this by-product of the forests will be more generally indulged in. People are just waking up to the advantages of outdoor sport.

If other interests must at times be sacrificed in order to preserve unusual bits of landscape for human use, and that will rarely if ever be really necessary, though possibly desirable, it will be justified on the grounds of the largest service to the public. Utility roads can often be varied to make it a little more pleasing or to reach some scenic point of interest, without materially increasing its cost or wasting the timber resource. Timber along scenic roads, unusually beautiful lakes or stream sections, can be left either wholly untouched or so cut as not to impair the beauty or charm of the landscape without a material loss of economic returns.

State foresters, in attendance at the National and State Parks Conference at Des Moines, Iowa, January 10-12, were responsible for the resolution recognizing the fundamental value of forest recreation and advocating the correlation of the recreational use of our National, State, county, and municipal forests with a like use on other publicly owned areas.

While there are among recreationists those who prefer privacy and isolation, those who are in search of knowledge of plant, insect, and bird life in the interests of science, the big majority is made up of visitors from large centers of population, to whom the operations of the lumberman and the flockmaster are interesting. The sawmill, or a band of sheep, is a novelty to the average tourist and just an added

attraction. The bigness and silence of the forest, without something to break the spell occasionally, gets on the traveler's nerve. True, a camp ground can't satisfactorily be used jointly by folks and cattle, but the total area that will be developed and permanently used for camp grounds will be so insignificant as to be unworthy of consideration. For instance, we have learned that on the San Isabel Forest, where a comprehensive recreation plan is worked out and in course of development, 240 acres designated as summer-home areas do not reduce the number of stock grazed; and the public camp grounds, including municipally improved areas, interfere not at all with grazing.

If in a few rare instances, and there will be some, especially beautiful landscapes prove to be of greater direct human value than their economic worth and it is clear that their charm and attractiveness will be destroyed by commercial exploitation, then obviously it will be wise to sacrifice the lesser interest to the greater.

An appreciation of nature, a stimulation of vigor of the mind and body, and the contentment of soul contributed by association with the forests, goes far toward making a useful and contented citizenry. If the American population can be made to feel contented and its effort directed to useful channels, enlistment in the Red organizations of this critical period of unrest can be averted. I can conceive of no more useful purpose the forests can be made to serve.

II

From a Silvicultural Standpoint

By M. W. Thompson

The two most common ways in which forestry and recreation meet in actual practice in the National Forests are:

(1) Where cutting operations are located on areas now used for recreation or likely to be put to this use in the near future; and

(2) Where sawmills or lumber camps are located on or near roads, camp grounds, or other areas of importance from the tourist standpoint.

Few instances have been reported where cutting in Forest Service sales has affected recreational areas. A case came up last year, however, where a comparatively small cutting had taken place along a main highway leading to a National Park, the cutting and brush dis-

posal having been in such condition as to interfere with the attractiveness of the road. However, much publicity has been given to recreation in recent years and it is evident that Forest officers are giving pretty close attention to cutting operations in such locations and, where warranted, are preserving certain areas against cutting. For example, along the Wind River road being constructed within the Washakie Forest, no cutting has been done upon a strip adjacent to the right-of-way. In contrast to this, there are many instances where cutting along roads located outside National Forests has seriously detracted from the scenic values. For example, along the highway running from Pagosa Springs to Durango, Colorado, practically all trees of merchantable size have been cut, making the scenery along such portions a barren waste, though it might have been kept attractive by leaving a fringe of timber along the roadway.

A similar contrast between sawmills located on National Forest lands and those located outside is usually evident. Pretty strict requirements as to the arrangement and clean-up of sawmills and lumber camps within the Forests are imposed, such difficulties as arise along this line usually being due to too lenient a policy having been followed by local Forest officers in allowing operators to locate their mills and camps without giving proper consideration to practical disposition of mill, stable, or camp refuse. Sawmill camps may almost invariably be reached by automobile and at the present time few passable roads are not used by tourists on camping or fishing trips. This means that the travelers get to see the camps. Summer homes are often located in the vicinity of lumber camps. For these reasons Forest officers are coming to realize more and more the need for giving greater consideration to the traveling public in the locating and upkeep of sawmills, camps and surroundings. Such camps, as well as the practice followed in handling Forest Service timber sales, should be matters of great interest to persons unfamiliar with the industry.

National Forest timber may be separated into commercial stands—those of value for the manufacture of lumber or other wood products and so located that they may be profitably logged, and non-commercial stands—those which, on account of quality of timber, or location, are not suitable for lumbering.

The areas of non-commercial forests are very extensive, the best estimate available for the State of Colorado, for example, indicates

that at least one-third of the timbered areas of the National Forests comes within this class. They include the areas on the headwaters of streams which are of primary importance for streamflow protection and regulation, and in which no cutting can take place for this reason, or since the quality of timber on such areas makes cutting impracticable. They also include stands or scattered trees, often of good quality, located in canyons, slide rock, steep or rocky areas where logging cannot be profitably undertaken because of the character of the ground, or because of the stands not being sufficiently extensive or dense, or of a quality to make exploitation profitable. In these non-commercial stands, particularly at the higher altitudes and on exposed sites, the most picturesque trees are found. Trees with peculiar twisted forms are found or dwarf trees the size of shrubs are common as the higher altitudes are approached. For the reasons indicated, no cutting will take place within the so-called non-commercial forest containing the timber for which there is the greatest need from a scenic standpoint for maintaining it in its virgin state.

A good many outdoor enthusiasts feel that even many commercial stands of timber should be maintained in their natural state, believing that where nature is disturbed esthetic values will be seriously impaired. The best example of carrying this idea to extremes—though I believe the danger of unrestricted cutting taking place also enters into the question—are the State Forests of New York. While this State has owned forests for many years, the cutting of all dead and green timber is still prohibited by statute. It has been my feeling, however, that there has been a good deal of misunderstanding along this line, many people laboring under the impression that cutting means devastation and seriously interferes with natural conditions. This is not strange, for until comparatively recently little conservative cutting of timber has taken place, and at the present the greater part of the lumber and timber products which are produced are cut from timber privately owned, according to long-established lumbering methods.

In contrast to the stand taken by the idealist, we have the lumberman who, in general, is able to appreciate trees only from the standpoint of the amount and value of the lumber which they will produce. He feels that all trees large enough to make merchantable material should be cut. This is natural, for he has found, if operating in private stumpage, that the carrying charges are almost invariably such as

to make it necessary for him to secure as high a return as possible from his operation and forego leaving immature trees for a future cut.

Forest management must therefore be the go-between between these two interests—the preservationist on one side and the lumberman on the other—as to the areas on which cutting shall take place and the degree of the cut. Use without abuse is the ideal condition, safeguarding scenic values and utilizing the mature timber. As brought out above, most of the timber in the more scenic locations is non-commercial and must remain uncut. There are also certain commercial stands of timber intensively used for recreation, or likely to be, which it is pretty generally agreed should be administered primarily for the development of their recreational values. For example: (1) Timber along traveled roads; (2) timber on community camp grounds; and (3) timber on islands or bordering on lakes.

While many scenic areas contain stands of commercial timber in which probably no cutting should take place, it is felt that the majority of them can be cut over lightly to advantage. The history of the forest is that if it is left to itself certain trees will grow to maturity and later become decadent. Others become suppressed and die. If no cutting takes place in stands becoming mature and overmature, a good many dead and down trees are usually found and fungus diseases or insect infestations are usually present. The usual mature forest also contains young growth and thrifty immature trees. The law authorizing the sale of timber from the National Forests gives as the purpose of cutting "preserving the living and growing timber and promoting the younger growth." The sound, thrifty young and immature trees are retained, and there is more chance of such trees remaining healthy than would be true if the stand were left in its virgin condition. Many types are much more accessible after an improvement cutting has taken place and the stand has been thinned, brush has been burned, etc. For this reason, and on account of the removal of dead and diseased specimens, stands improved as indicated, are much more attractive to many than if they are left in their virgin condition. A good example of such an improvement cutting was occurring on Star Island and nearby sections and points on the Minnesota Forest, extensively used by tourists, where approximately $37,000 worth of dead and badly diseased timber was removed three winters ago. From the appearance of the remaining stand, it was difficult to tell that any ma-

terial had been taken out. Marking in regular commercial sales is somewhat heavier than this. Sample marking on areas of typical lodgepole and Engelmann spruce show that about 45 per cent of the number of trees 10 inches and over in diameter at breast height are marked for cutting. In addition, there is usually a large number of poles 6 to 9 inches inclusive and smaller trees which remain.

The more publicity that can be given the work of the National Forests, the better. There is an excellent opportunity for much to be done through recreation. Tourists visiting timber-sale areas are almost invariably favorably impressed by the cutting practice and brush disposal methods followed.

A report from the Pike Forest shows that 65,000 persons traveled the Pikes Peak Auto Highway last year where approximately 6,000 acres of successful plantations have been established by the Forest Service; 27,000 persons used the Pikes Peak Cog Road where the planting is to be undertaken next season. Tourists are particularly interested in nursery and planting work and are bound to tell about what they have seen. The more timber sales, sawmills, nurseries, plantations, and other activities that can be brought to the attention of tourists, so much faster will the Forest Service idea become better known. This point is well brought out by Forester Greeley in his address at the State Foresters' Convention at Harrisburg, Pa., last winter, when he made the statement that "Every National Forest is like a settlement home in a tenement district. It becomes a center for demonstration and practical education in forestry."

THE PINON-JUNIPER LAND PROBLEM

I

SHOULD THE PINON-JUNIPER LANDS BE INCLUDED IN THE NATIONAL FORESTS?

By D. S. Jeffers

Supervisor, Uncompahgre National Forest

In general the Uncompahgre Forest boundary is above the pinon-juniper lands. The one exception is along its western side sloping to the Dolores. Here some two miles of the type lie within the Forest. My observation of the type is confined within this area.

It is a distinct type, first met when traveling from the non-timbered plains and valleys to the mountains, being from eight to ten miles in width. The elevation is from 6,000 feet to 7,700 feet. Dry exposed mesas, low, dry mountain slopes, and canyon sides on all exposures indicate its location. The soils are thin and rocky, coarse gravels, and light sands. The prevailing sandstone formation is often exposed.

The stand is open and of an average density of 3.7. Sagebrush and grama grass predominate in the ground cover. Prior to the Indian exodus the growth of this grass was dense. The dry, inflammable condition of the ground cover accounts for the extensive, destructive fires reported as annually occurring during the late autumn. Now the grazing of stock in large numbers almost precludes the possibility of fires of any extent.

Precipitation, chiefly in the form of snow, does not exceed twelve inches annually. The rainfall of July and August is from local thunder showers. One outstanding characteristic of the type is the dry and hot climate. An index of the moisture supply is seen in the laterally developed root system in its search for moisure in the porous, decomposed sandstone soil.

These brief statements on location, extent, soil, and climate are preparatory to the contention that the lands should be included in the National Forests. Inasmuch as my observation has been limited, the conclusions must be general.

Present Use.—There are three distinct uses made of these lands, each making a definite contribution to the community.

The chief present use, because it is shared by more people, is that of grazing. The stock industry is recognized as the leading activity of the southwestern part of the State. In the San Miguel and Dolores valleys cattle are raised almost exclusively. The climate of the average year is such that stockmen graze steers and the hardier cows throughout the winter. White sage and grama grass, both excellent winter feeds, and the protection of the low crowned pinons and junipers combine to make an unusually valuable range for cattle. In the Uncompahgre and Gunnison valleys the sheepmen and cattlemen divide the use of the lands about equally. Due to overgrazing, chiefly by nomadic sheep in the past, the value of these lands in the valleys just mentioned is not as high as that on the western side of the Forest.

Second in importance is the use of the forest cover for fence posts. Good post material is becoming scarce. Evidence of this is the necessity for going farther back each year and reconnoitering quite a little to locate suitable trees. The value of juniper for fence posts is not questioned. The value is generally recognized, which accounts for the extensive shipments made and being made from time to time.

Of almost equal importance, and surely of equal *value* locally is that of the fuel secured from the pinon and juniper. The free use privilege exercised by so many indicates the extensive demand for fuel by settlers in the valleys. The rapidly diminishing accessible supply of fuelwood in "the Cedars" accounts in a large measure for the demand made upon the Forest Service for the fuel at the higher elevations.

The agricultural use of these lands is growing less and less, and was not included in the distinct uses mentioned above. Only moderately successful farming is possible and then under the best conditions. It is true that in the canons cut into the sandstone formation, where conditions are most favorable there are some very good ranches. On the typical pinon-juniper lands—the mesas—the farming can be made successful enough to maintain a family in food and clothing provided there is sufficient water for irrigation. Some of the larger parts have been settled by a group of people interested jointly in an irrigation project. For the period of sufficient water their crops do well, but the water is not sufficient for the season and they have all the water available, unless a reservoir is constructed and the expense of that is such that there is not enough of the pinon-juniper land bordering the valley to justify the effort. Dry farming is out of the question.

Land listed for entry within the Forest has not been filed on in several instances and plans are on foot to have the lists recalled. In other instances where entry has been made settlement has not been effected. In still other instances, outside the Forest the claims have been abandoned after settlement. The general agricultural use of the land at present has certainly been settled through actual effort.

The question of the subject must undoubtedly be answered in the affirmative.

Future Use Within the National Forests.—Granting that the forest growth on the pinon-juniper lands in the eastern Rockies is not a merchantable timber in the strictest sense of the term, nevertheless, it *is timber*, is put to a practical use, and is essential to the agricultural economy of the locality where found. Therefore the pinon-juniper lands should be classed with those lands qualifying in a larger degree as potential National Forest land and justifying the chief object for the creation of the National Forests.

By "insuring a perpetual supply of" pinon and juniper on the National Forests a distinct contribution is made to the agricultural settlement, development, and improvement of the adjacent territory. This is accomplished through the growing of valuable fence posts, telephone stubs, and fuelwood. No argument appears necessary for the statement that the economic need for an annual supply of fence posts is justification for placing the species under forest management.

The moisture conserving value of these lands is relatively small. The snows disappear early and the resulting run-off reaches the valleys before the water is needed. But the great value of this forest cover is the prevention of erosion. The prevailing soil erodes easily and quickly, as evidenced along wagon roads and trails. Since erosion is so intimately related to the maintenance of a normal, natural balance the conservationist is warranted in fostering measures to prevent it. The continuance of this forest cover of pinon and juniper will accomplish the result. The necessary practice of forestry which will bring this about can be done only by the Federal Government.

"To provide for the use of all resources" would include, when considering the pinon-juniper lands, the resource of forage. I believe the time is not far distant when that resource will be emphasized by the interests most vitally affected in an effort to add to the National Forest the very lands under discussion. Further discussion of that resource is hardly pertinent to the question.

Were these land within the National Forest, management should at once refuse the cutting of green timber under free use, and plan the rotation with the future use of the species in mind and not only fence posts. It is my conviction that the pinon and juniper have other uses which will be developed later.

All timbered lands should be conserved under government control. When all other tillable lands have been demonstrated as insufficient for the maintenance of the proper balance between the practice of agriculture and forestry, then will there be ample time to classify the lands intensively on the basis of the best judgment as to practicable agricultural lands. In that statement I am not at variance with the land classification policy, rather I am anxious that the timbered lands, if they have any merchantable product of value in the locality, shall be conserved for their timber values and timber potentiality.

All of the uses to which these lands are put are identical with those of adjacent lands within the National Forest. Similar lands within the Forest are not handled differently from other lands. If the resources are evident and present, if the development and prosperity of the locality are dependent upon the perpetuation of these resources, and if these resources are not being properly handled under the present plan and are often being wasted, then it is high time that Federal jurisdiction be given an opportunity.

The pinon-juniper lands should be included within the National Forest.

II

PLAN FOR HANDLING THE PINON-JUNIPER TYPE.

By A. F. Hoffman

Supervisor, Montezuma National Forest

For several years I have been intimately associated with the pinon-juniper lands of southwestern Colorado and have also been over many such lands in the eastern and southeastern part of the State of Utah.

They make up a distinct forest type and extend up to the yellow pine type, which, in this region, constitutes their upper limits, and down to the sagebrush lands. Within the type there are frequent sagebrush parks in the broad-bottomed canons and scattered through the timber.

As I know them, the lands supporting the type are low ridges, wide mesas or sometimes prairielike, cut up by deep rocky canons, with a scattering of small knolls which appear from a distance as islands. The soil, which is largely the result of the decomposition of sandstone or shale, mostly the former, has poor moisture retaining ability.

At present, the type is in very poor condition. Because of its altitudinal limits it does not receive as much precipitation during the summer months, but is subject to more drying winds than the other forest types of the region. The winter precipitation does not do it as much good because the snows usually melt rapidly and the resulting water runs off instead of going into the ground.

Very heavy overgrazing has been done especially by sheep and goats, and this grazing has seriously injured any reproduction that has become established and destroyed much that has started.

Crown fires have occurred that have totally destroyed many acres of trees and countless ground fires have run in past years that destroyed reproduction and injured the larger trees, allowing fungous diseases to get a hold and spread with great rapidity. The greatest part of the farming of the region is done on lands located in this type. Much of the fuel and pole and post material that is used on the farms is obtained from the type, and unregulated, injurious handling of the stand has resulted. Large openings have been made that have allowed erosion of the soil to go on unchecked and the drying winds to get a better entrance to the stand. These factors have not only hampered the natural progress that should have occurred in the type, but have seriously impaired its condition, so that now it is losing ground, and, in time, if its present treatment is continued, will be entirely eliminated.

In order to determine whether or not all of the lands making up the type should be used for forest purposes, it becomes necessary to analyze the present use of any lands that are not now so being used. For the sake of this analysis, I will consider grazing to be a use for forest purposes, leaving agricultural and forest purposes as the only two uses for which the lands making up the type are valuable.

Throughout the region with which I am familiar, almost all of the level areas and the stream valleys have been or are being devoted to some kind of farming. Fruit, hay, and grain are the principal crops produced, and with the exception of the fruit farms, the lands are used entirely in connection with the live stock industry. All of these

lands that are being irrigated are producing paying crops and are undoubtedly being put to their highest use. The ones that are popularly termed "dry farms" are those situated in the higher or rougher parts of the type and are not irrigated because of the prohibitive expense of getting water to them or because it is impossible to do so. It is my opinion that these "dry farms" lands are not going to give a sustained yield of paying crops and that they would yield a higher annual money return if they were producing timber.

The region between Dolores, Colorado, and Monticello, Utah, is now largely made up of the "dry farms" and the popular opinion is that they are highly successful, but I have found upon investigation that they are not. For the last few years the summer precipitation has been unusually favorable for dry farming activities, both because ot its amount and the time of its coming. In the Paradox and Gypsum valleys, which are between the Montezuma and Uncompahgre Forests, are thousands of acres that were once considered valuable for farming purposes. They have been abandoned because the repeated so-called "drouths," which were not that, but a natural climatic condition, made successful crop production impossible. These last-mentioned lands are very similar to those in the Montezuma Valley and I believe that the experience had there will be repeated in the Montezuma Valley. It is my opinion that if there were a very few dry farms scattered through the pinon and cedar type, the protective effect of the timber stand might make farming them successful. But the wholesale clearing of these lands with a later farming of them results in increasing the factors that dry out the soil, that is, the drying winds get an unrestricted sweep at the soil and no protection is on the ground to hold the snowfall and to let it melt slowly. The rainfall that comes during the growing season is usually heavy and a very large amount of the water runs off, thus failing to give the soil the amount of moisture that it is entitled to. My contention is that any of the land in the type that is capable of being irrigated should be devoted to agriculture, but that all that can not be irrigated should be used for the production of timber.

As I see it, the greater part of these dry lands are going to be abandoned some time in the future and that will leave a large area in the pinon-juniper type of land that will rapidly become barren unless planting of trees is done. Great harm to the region as a whole will

result because the protective timber cover will be gone and the source of the timber products that the type yields will be greatly reduced.

The present value of those timbered lands that yet remain in the type for forest purposes, from a protective standpoint, of course, is still fairly high. I know an instance of the fruit on a farm, entirely surrounded by pinon and juniper timber, not being frozen in June when all of the fruit on the trees not so located was frozen. The post and pole yield is now limited because the old stands have been heavily cut, and there is no new crop growing up for future cutting. The stand is rapidly assuming an open nature, made up of bushy-topper, many-branched trees. These, of course, do not have much value except for fuel. To compare the value of the land for forest or for dry farming purposes, it is necessary to consider what the land, if properly handled, is capable of from a forest standpoint.

My system of handling the entire area embraced by the pinon-juniper type would be:

1. To make an intensive classification of it and to designate those lands which can be irrigated with reasonable expense and which are not too rough to be farmed, as agricultural and have them used for that purpose.

2. To consider all of the remaining lands as more valuable for forest purposes and handle them accordingly. The method of handling would be as follows:

(*a*) Adopt a selection system of cutting at once, which will have for its object taking from the stand the mature and overmature trees and reserving the immature trees, but never removing enough to make large openings.

(*b*) Considering the type for the production of pole and post material only from the juniper trees and ties and fuel from the pinon trees.

(*c*) Depending on natural reproduction for a continuation of the stand.

(*d*) Prohibiting all summer grazing, but allowing spring and fall grazing of cattle and horses, also sheep and goats, after ten years subsequent to any cutting.

(*e*) Prohibiting all grazing by sheep and goats for ten years after each cutting.

(*f*) Considering the rotation to be 80 years.

(*g*) Establishing an effective system for protection against fire.

By following this method the pinon-juniper type of land will become of the greatest value to the region that they serve. The recommended disposition of them and the method of handling them can only be brought about by making them a part of the National Forests and they should, therefore, be added to them as soon as possible.

The benefits to be gained by so doing will be:

1. A sustained yield of cedar post and pole material and pinon fuel will be made available for the region tributary to the type.

2. The much needed protection afforded to the farming lands by a timber cover will be insured.

3. The pinon-juniper lands being naturally warmer and having an earlier opening of growing season will be ready for grazing sooner in the spring than the ranges now included in the National Forests and they can, therefore, be used for that purpose, making possible the keeping of stock off the present National Forest ranges until they are ready.

4. The snowfall will be conserved.

There will be strong objections raised by many interests to the withdrawal of the so-called dry lands from farming use, but I have shown that the use of such lands for forest purposes will result in the greatest good for the greatest number. The problems involved in taking over the pinon-juniper lands and putting them under management are the kinds that the men in charge of the National Forest are constantly solving, consequently the lands should be turned over to them at once.

DISCUSSION

In the discussion which followed, a few of the leading points brought out are summarized below:

Keplinger thought that the use of this type under Forest Service management would be about the same as it is under private control, and that it makes little difference whether these lands are inside or outside the Forest boundaries. Most of the business would be free use or S-22 sales which would be handled with very little supervision and in practically the same way as this material is now cut, except for a little more care to prevent denudation. Regulated grazing seems to be the best argument for the inclusion of these lands, admitting that grazing is a legitimate use for their addition.

Hatton remarked that agricultural use in the pinon-juniper type is small compared to the total area and that these lands might just as well be included for the purpose of supplying range for early spring and late fall, at which period the forest ranges can not be used and it is too early to put the cattle on alfalfa.

Barker suggested that the use of this type for winter game range might be a reason for their addition, since we are advocating game conservation.

Peck stated that the returns from this type of land would not be commensurate with the cost of administration and that the petty annoyances due to timber and grazing trespasses would be much greater than on the Forests as now constituted. He also thought that the utilization of the timber on this land would practically approach mining, for after cutting in this type it seldom replaces itself and it has been noticed that settlers are forced to go farther back each year for material.

Philips stated that reproduction has come in in certain localities following cutting by settlers and that some of the earliest settlements in the State have been made within or close to this type, and that in such regions the timber has not disappeared. He also stated that he believed there were small areas in this type that will fit in with the administration of certain National Forests and they might readily be included by reason of better growth of pinon and juniper timber and the possibility for its utilization.

Ramskill stated that in the Uncompahgre country, the full upper third of the pinon-juniper type will support yellow pine, as is evidenced by the isolated yellow pine trees occurring within the type and the number that have been cut in the past. He also stated that planting at the Transfer Ranger Station, which is at the edge of the pinon type, was successful, and he thought that this land ought to be put to use in raising timber in view of the nearing exhaustion of the timber supply in the United States.

Bates remarked that through planting certain types can be extended beyond their natural limits but that this is expensive and the results are unsatisfactory.

Pearce remarked that the same effort exerted in more valuable timberland would be better spent than in trying to develop the pinon-juniper type. If we make what good timber producing land we have productive, we will be able to raise all the timber required for our needs.

Granger remarked that when the subject was given out, it was intended only to apply to the foothill type adjacent to the National Forests and not large areas including pinon-juniper mesas far distant from the boundaries.

Stahl thought that the subject should have been confined to this scope, stating that the policy now is to block our holdings rather than to get larger areas of pinon-juniper far removed from the National Forests.

Hatton thought that where areas adjaçent can be added and there is no possibility of their use for agricultural purposes, he would advocate their inclusion.

To summarize the views of the members present at the discussion, two questions were put up for vote: (1) Should the pinon-juniper type as a whole, in areas large enough to administer properly, regardless of their distance from the present National Forests, be added to the Forests? This proposal was voted down. (2) The second proposition was: Should the pinon-juniper land that can be readily administered with existing forest units by extending the present boundaries of the National Forests, be added? A favorable vote was secured on this proposition.

By Ress Philips

Before we can even start a discussion on this subject, it seems to me that we must define the term pinon-juniper lands. Jeffers is evidently talking about a small strip of land along the west side of the Uncompahgre, while Hoffman is thinking about the country between the yellow pine and the sagebrush types. I can not agree with either. The area is much larger than Jeffers admits, and as I see it, the yellow pine and sagebrush meet and intermingle. There is no zone between them.

To me the term pinon-juniper lands means an immense area which geographers have named The Great Sage Plain. It covers the southwestern part of Colorado and extends far into Utah and northern Arizona. As I remember it, somewhere around 50 per cent of the area is covered with sagebrush, the woodland type occurring only in patches on the mesas, but occupying nearly all of the rougher land.

The annual precipitation for the region is about 10 inches, and hot dry summers and mild open winters are the rule. As brought out by

Hoffman, these broad rolling mesas, when irrigated, are well adapted to the growing of fruit, grain, and alfalfa. The pinon and juniper land when cleared is more productive than the sagebrush land and some of the best farms of the region were, a few years ago, covered with scrubby timber.

Since the early settlement of that country, the woodland types have been considered a hindrance rather than an aid to colonization and as a result, local custom has decreed that pinon and juniper lands are not timber lands in the broad sense of the term.

A great deal of the agricultural land was patented under the Desert Land Laws, as was proper since it was valueless for that purpose without expensive irrigation systems. Timberlands are not subject to entry under the Desert Land Laws and the Department of the Interior has held that pinon and juniper lands are not timberlands within the meaning of the law, thus bearing out the contentions of the early settlers and establishing a precedent.

In my opinion, the stand was well taken. Any other policy would have retarded if not prevented settlement and development. I believe that any man who has visited the prosperous Mormon settlements of the Southwest will agree with me.

The problem of classification as suggested by Hoffman is more complicated here than it is on the lands now within the Forest.

The limitations imposed by climate at the higher elevations do not apply here. While the settler on the pinon-juniper lands must face many adverse conditions, they are not impossible to overcome as is the case with an unfavorable climate and a very short growing season in the mountains. With water for irrigation success is assured now, and who can forecast the future, with the prospects for better methods of farming, new crops better adapted to conditions, and gigantic irrigation enterprises which it holds in store.

While the agricultural value of these land may be low, can we show a real forest value as we can on the National Forests?

I doubt if the woodland type has any protective value except as it affects erosion and the timber, if we must call it timber, is of poor quality and its prospective commercial value is not high. Even if we could classify the land and segregate all the irrigable parts as suggested by Hoffman, what would we have left? Hoffman states that in the part he is familiar with, almost all of the level areas and the stream valleys have been or are being farmed.

Is it not only possible but probable that the continuity of the lands has been broken to such an extent that administration would be expensive and impracticable?

The proposition of growing timber on these semi-arid lands is unpromising at best, but with the good soils in private ownership, leaving only the canyon slopes, rim rocks and other rough parts, the outlook would seem discouraging indeed.

Would the adoption of Hoffman's plan of management be practicable? Are his principles sound and in accordance with the opinions of research workers? We must not forget the form and size of the trees to be grown and the enormous waste which results from cutting ties and posts from them. As a rule a fully developed pinon tree will make only one standard gauge tie and only the best of them will do this. The labor involved is a big item. The remainder of the tree is only fit for fuel and there is no demand for this except from the settler, and a farm woodlot would take care of him.

Juniper makes excellent fence posts, but this is a small item in these days of iron and concrete. While the problem may have a local aspect, I doubt if it is of much importance.

I was very much surprised at the argument for fire protection, for I was ignorant of a real fire menace in this type. The stands are broken up into comparatively small fire units by the many canyons and rim rocks, and conditions on the whole do not seem favorable to the spread of fires.

Injury from overgrazing is no doubt apparent, but I doubt if it is any worse on the pinon-juniper land that it is in the intervening sagebrush areas.

I can not agree that grazing is necessarily a forest use and in itself a sound argument for including lands in a National Forest. If we accept the argument presented we must advocate the inclusion of practically all of the public land in the Western States. Would such a move be desirable even if possible?

In our discussion we should evidently adhere to Service principles and in doing this we should try to look far into the future. If you want to look into the past, you will find that this region once supported an agricultural population and a civilization dating back to the beginning of the Christian era.

Nature does not, in my opinion, put all lands to their highest use and the fact that lands in their natural state support merchantable timber, pinon-juniper, sagebrush or only grass, is not conclusive evidence that they are chiefly valuable for that purpose.

If these pinon-juniper lands are included in the National Forests, it seems to me that we ought to decide beforehand just what we will do with them.

It is, I presume, clearly understood that I am not talking about any area in particular, but about the type in general.

GROWTH AND ITS RELATION TO THINNING—SAMPLE PLOT STUDIES IN MIXED HARDWOODS

By C. H. Guise

Department of Forestry, Cornell University

The amount of wood that is produced per acre in the various kinds of woodlands is commonly estimated in a more or less general way. The expression that a thrifty woodlot should produce a cord or half a cord of wood, as the case may be, per acre per year, is one with which we are all familiar, particularly when woodlot forestry is under consideration. Obviously such statements will be general, as they must be, until growth studies in specific localities with definite kinds of forest cover, give us the information which will permit talking in exact and decisive terms. Our scanty knowledge about growth and increment is almost axiomatic, and while the following paper does not add much, it will contribute a small bit of information on increment, in the young mixed hardwood stands so common in the Eastern United States. The results are based on sample plots, and cover a period of 5 years' growth.

In the early spring of 1914, the Department of Forestry of the New York State College of Agriculture established three sample plots in a 30-acre woodlot near Mapleton, Cayuga County, N. Y. To determine the effect, if any, of thinnings of various grades in the rate and amount of growth that would follow was the object in view when these plots were laid out. The work was outlined by the late Prof. Frank B. Moody in co-operation with members of the Forestry Department at Ithaca, and actually carried on by him with several assistants of the Department.

The woods in which the plots are located were cut over 25 years prior to 1914. An even-aged stand had resulted, about 30 feet in height, and composed of a mixture of a great many species; hard maple, soft maple, basswood, hickory, elm, red oak, white oak, white ash, tulip poplar, butternut, black cherry, and iron wood were all present in various degrees of mixture, though well scattered over the whole woodlot. Trees had come up both from seeds and sprouts.

Although the number of species was large, the way in which they were scattered rendered the selection of plots of uniform character fairly easy. Density of stand, age, and height were the same throughout, and all trees were found in extremely thrifty and healthy condition.

The level character of the land, and the deep, rich, well-drained clay loam are also factors to be kept in mind when going over the results of the first 5-year period.

Three square plots, each one-quarter acre in area, were laid out, each one being surrounded by a strip 30 feet wide, these adjacent strips being accorded the same treatment as the plots. Corners were marked with 5-inch cedar posts. Plot I was untouched, being left as a check. Plot II was heavily thinned and Plot III lightly thinned.

Every tree in each plot was measured in diameter at right angles, the mean being used for the calculations. At the time of measurement each tree was numbered, the number being painted at d.b.h. in bright red paint. Parenthetically it should be added that such numbers can only be seen with difficulty after 5 years, and frequent remarking is necessary. Last year the trees were tagged with zinc identification marks.

The original plans were to make remeasurements of every tree every five years. The first 5-year period ended last year, and the following data show what had taken place.

The points of most striking interest in the following tables are that the greatest increases in both diameter growth and volume growth took place where the thinning was heaviest; that results intermediate between those from the check and heavily thinned plots are found in those figures secured from the lightly thinned plot.

TABLE 1

Plot No.	Treatment	Range of diameters (inches)	No. trees removed	Total basal area of trees removed in thinning, per acre basis (square feet)	D.b.h. mean sample tree (inches)
I	Check	2.0-10.2	...	.....	....
II	Heavily thinned..	2.0- 9.6	104	35.77	3.97
III	Lightly thinned..	2.0-10.4	71	21.30	3.70

TABLE 2.—*Mortalities, basal areas,*[a] *and diameters, 1914–1919.*

Plot	No. trees		Total basal area, square foot per acre		D.b.h.-M.S.T. (inches)		Increase in d.b.h.		Current annual increase	
	1914	1919	1914	1919	1914	1919	Inches	Per cent	Inches	Per cent
I	163	155	76.05	95.85	4.62	5.32	.70	15.15	.140	3.03
II	86	83	41.38	62.17	4.68	5.85	1.17	25.00	.234	5.00
III	94	94	47.58	67.59	4.80	5.74	.94	20.00	.188	4.00

[a] 1914 measurements in plots II and III apply to conditions immediately after thinnings had been made in each plot.

TABLE 3.—*Volumes—1914–1919.*

Plot	Vol. av. tree, cu. ft.		Volume per acre				Current annual increment, per acre		
			Cu. ft.		Cords		Cu. ft.	Cords	Per cent of vol.
	1914	1919	1914	1919	1914	1919			
I	2.27	3.01	1,480	1,866	17.41	21.95	77.2	.90	5.20
II	2.34	3.65	805	1,212	9.47	14.26	81.4	.96	10.12
III	2.46	3.52	925	1,324	10.88	15.57	79.8	.94	8.62

The greatest actual volume present in 1919 is found on the check plot. It must be remembered, however, that almost half the trees in plots II and III were removed in thinnings, and that the actual volume growth shown in the tables has taken place on the trees that were left. In other words, the volume in 1914 on plot I was almost twice that on either plot II or III. In spite of the much smaller base on which to start, the actual increment in each of the two thinned plots is slightly greater than on the check plot. The per cents of volume increment are of much greater value in this connection than a mere statement of the actual volume increase in cubic feet or cords.

The mortality rates shown in Table 2 about 4.9 per cent for plot I, 3.5 per cent for plot II, and none for plot III are also of interest.

Where only three plots are used, and only one 5-year period has passed, it would hardly be wise to make statements that are too broad. The data given in this paper are merely of a preliminary nature, and not until several more of these 5-year periods are past will the drawing of certain and definite conclusions be warranted.

FORESTRY IN BRITISH INDIA

By T. S. Woolsey, Jr.

C. G. Rogers, formerly Chief Conservator of Forests in Burma, British India, lectured at Yale University, February 24, on "Forestry in British India," on the following topics:

1. Introductory.
2. General description of the country, topography, geology, soil and climate.
3. Area of forests in India. Their ownership, Government forest policy.
4. Principal types of forest, their composition and distribution. The most valuable species.
5. Brief history of the origin and development of the Forest Service in India.
6. Present organization of the Forest Service.
7. Educational and research work.
8. Revenue and expenditure. Nature and scope of the work of the Indian Forest Service. Estimate of timber available for export.

Few Americans realize that the combined area of India and Burma is only a little more than one-third that of the United States and on this smaller area there is a population about two and one-half times that of the United States. It is illustrative of the varying density of population when one realizes that in Burma there are only fifty-three people to the square mile, while in Bengal there are five hundred seventy-seven. The complications which the native village population means to the forester may be well understood when one realizes that India "is essentially an agricultural country, the vast majority of its inhabitants cultivate the ground, or raise cattle." There is little skilled labor, but ordinary day labor perhaps one-third to one-half as efficient as the ordinary Italian in America, is plentiful and costs under 25 cents a day. The unskilled character of the labor, however, makes efficient forest control doubly difficult and great credit is due the British foresters for their splendid success in administrating and improving an area of some 367,909 square miles that produce an annual net revenue of some $6,000,000. According to Rogers, a definite statement of Indian forest policy was not made until 1894.

"The regulation of rights and the restriction of privileges of user enjoyed by the inhabitants of the immediate neighborhood are justifiable only when the advantage to be gained by the public is great.

"In the application of this principle, forest lands should be broadly classed as:

(*a*) Forests, the preservation of which is essential on climatic or physical grounds.

(*b*) Forests which afford a supply of valuable timbers for commercial purposes.

(*c*) Minor forests.

(*d*) Pasture lands.

"Forests of class (*a*) are generally those essential to the preservation of hillslopes and the regulation of destructive torrents, and so long as there is reasonable hope of the restriction being effective they should be strictly protected. The second class of forest should be managed mainly on commercial lines as valuable State properties and sources of revenue. Even here forest income should be subordinate to the reasonable requirements of the local inhabitants. In the third class of forests (*c*), useful chiefly for the supply of fuel, fodder or grazing, local interests come first. The claims for cultivation should be recognized as stronger than the claims of forest preservation. Forest lands may be diverted to agricultural purposes provided the cultivation is permanent, does not honeycomb the forests with fields and settlements, or encroach on the minimum forest for general needs; and provided also that the forest is not essential to the preservation of the tract."

Roger confirms the six types of forest described by Ribbenthrop:

(1) Evergreen forests, (2) Deciduous forests, (3) Dry forests: Due to rainfall only.
(4) Alpine or hill forests. Due to elevation.
(5) Tidal forests. Due to the influence of the tides.
(6) Riparian forests. Due to the overflow of rivers.

In 1805 steps were taken to combat the growing deficiency of oak for British naval construction by working the teak forests on the Malabar Coast, but through private influence the efficient management which had been secured was abolished in 1823. In 1842 forest conservation was again revived and a small local forest department for Malabar was organized; in 1847 the Bombay Conservator of Forests was appointed, and in 1827 a special examination of the forest resources of Burma was authorized. In 1837 the serious absence of young growth was reported and when in 1852 the Province of Pegu was annexed by the British (now Lower Burma) all forests were declared to be govern-

ment property and a superintendent was appointed. Technical forestry in British India was, according to Mr. Roger, really commenced in 1856, when the late Sir Dietrich Brandis was appointed Superintendent of Forests in Pegu. From this time on, there has been a steady development along technical lines as well as in administrative organization, and in the successful commercial management of a vast forest property.

The latest development is the greatly increased appropriations for research and in the introduction of American logging methods through hiring two American logging superintendents, and by training some seventeen young British engineers in American methods of logging.

The forest aministration of each large province is under a Chief Conservator, or Conservator (corresponding to District Forester); the divisions or sub-divisions under a Deputy Conservator (or Forest Supervisor); the ranges under a Ranger and the beats under a Forester, the lowest grade. The policy is control by the Government of India through an Inspector General under general financial rules which are laid down, resolutions on policy, personal inspection, by reserving the right to appoint conservators and Chief Conservators (except in Madras and Bombay), by forest legislation and the imperial forest code (except Madras and Bombay which have their own special codes), and lastly through the civil service regulations, civil account code, and the general laws.

According to Rogers:

"The Inspector-General of Forests is the chief adviser to the Government of India and to local governments in the management of State forest property. He communicates direct with local heads of the service on purely professional matters when he may require information or desire to make suggestions; copies of any important letters are communicated to the Government of India and the local governments concerned. During a large portion of the year he tours through the forests and records his recommendations. Except in Madras and Bombay plans for the working of the forests are prepared in consultation with him, or, if prepared under the supervision of a Chief Conservator, communicated to him so that he may have an opportunity of making suggestions to the local governments. Subject to the control described, local governments of the major provinces are responsible for their own forest administration. The Chief Conservators, or Conservators, are their immediate advisers in forest matters, and spend a considerable part of the year touring; they control all forest business within the financial or other powers accorded to them. In the major provinces forest revenue and expenditure were wholly provincialized in 1911 on the recommendation of the Royal commission upon decen-

tralization; prior to this equal shares were allotted to the Imperial and Provincial budgets. In the minor provinces (Coorg, Ajmer, Baluchistan, and the Andamans) both forest revenue and expenditure are Imperial. Working plans are brought into force after sanction by the local government, and the same authority is required for any considerable deviation from the prescriptions of plans approved. Forest manuals have been published, or are in course of compilation, for most of the major provinces; they contain rules made on the authority of the forest law in force, notifications defining the powers of the various forest authorities, and standing orders regulating forest administration generally. Revenue and expenditure are audited by the provincial accounts authorities; Conservators or Chief Conservators control the management of the forests and returns of forest produce.

"Divisional forest officers are responsible for carrying out the provisions of working plans. Where a regular plan has not yet been compiled, they have to prepare and carry out an annual plan of operations. They control revenue and expenditure subject to definite financial powers. When on tour they check the works in progress, control protection of the forest, and demonstrate various silvicultural operations. They have to initiate schemes for the development of their forests."

In 1905 there was practically no research work in India with the exception of a few poorly laid out and ill-considered sample plots. Today a $2,000,000 experiment station has been authorized and a complete research staff has been organized.

The criticism has been made that financial considerations have had too much weight with many British India foresters. The rupee, it was alleged, was put ahead of silviculture. According to Rogers:

"Since the foundation of the forest department, fifty-six years ago the revenue (both gross and net), expenditure, have risen continuously, as will be seen from a perusal of the subjoined figures taking £1 to be $4:

Five-year average	Gross revenue, dollars (thousands)	Expenditure, dollars (thousands)	Surplus, dollars (thousands)	Percentage of expenditure to gross revenue	Value of free grants, dollars (thousands)
1864-69	996	636	360	64	——
1884-89	3.112	1,980	1,132	64	——
1904-09	6,852	3,760	3,092	55	1,064
1914-19	9,904	5,632	4,272	57	2,324

"The expenditure during the last quinquennium was curtailed on account of the war. During 1918-19 it was 61 per cent and is becoming normal.

"While the cost of the establishment per square mile of forest controlled has not materially increased since 1884-89, the net revenue per square mile has increased from nearly $13 to nearly $19.

"The gross revenue per square mile of forest controlled varies from $205 (net revenue $196, value of right holders produce and free grants, $9) in the Northwest Frontier Province, where the area of forest is 236 square miles, to $13 in Burma ($12 and 1, respectively) with its 146,000 square miles of forest, of which nearly 117,000 are unclassed, and its small population.

"In the year 1918-19 the gross forest revenue was more than 14.6 million dollars, while the expenditure was a little over 8.5 million dollars, and the net revenue over 6 million dollars."

Working plans were commenced in 1872 and to the end of June, 1919, they covered 60,670 square miles, and the recognized methods of treatment (except Bombay) were as follows:

	Square miles
Clear fellings	263
Shelterwood compartment system	552
Group system	95
Selection system with improvement fellings	15,914
Coppice system	1,009
Coppice with standards system	7,060
Improvement fellings	12,254
Other systems	15,955
Total	53,102

It is of interest that in the Central Province 85 per cent of the forests are under working plans, while in Burma (where the conditions are far more extensive) only 4 per cent. Three years ago the Indian Forest Service aimed to protect over 46,000 square miles and 96 per cent of this area was successfully protected.

"The average annual cost of protecting 50,400 square miles during the quinquennium 1909-14 was a little over $14,800. Since 1914-15 the area under fire protection has decreased by a little over 4,300 square miles. In Burma, the Central Provinces, and Assam, the decreases were 3,200, 1,700, and 1,300 square miles, respectively; while in the Bombay Presidency the area increased by 1,200 square miles. The percentage of the forests under fire protection of the total forest are, varies from 2.9 and 4.6 per cent in Assam and Burma, respectively, to 85.5, 93, and 96.5 per cent in Madras, Bombay, and Bihar and Orissa, respectively. During the year 1918-19 there were just under 4,900 fires; the area burned being just over 2,200 square miles. The following shows the percentages of fire by number and area burned, classified according to cause as far as known:

	Percentage	
	By number	Of area burned
Originating in departmental burning operations......	4	3
Crossing external fire lines..........................	11	26
Due to carelessness of outsiders....................	24	13
Intention and malice..................................	23	19
Cause unknown	38	39
	100	100

"Except in Burma, the number of thousands of animals allowed to graze in government forests was as follows:

	Buffaloes	Cows and bullocks	Goats and Sheep	Camels	Other animals
At full rates..................	593	1,683	1,246	38	11
At privileged rates...........	326	3,389	704	—	18
By right under settlement.....	369	1,586	1,417	—	188
During the pleasure of government	221	1,381	129	9	14
Total....................	1,509	8,039	3,496	47	231

"The intensity of grazing varies very much with the province as will be seen from the figures given below for Burma and the Central Provinces. In Burma grass outside Government forests is as a rule plentiful, the population is small and a total failure of the monsoon rains is unknown. The number of animals grazed in Burma is as follows:

	Buffaloes	Bullocks and cows	Sheep and goats	Other animals
At full rates.........................	7	23	1	—
At privileged rates..................	—	—	—	—
By right under settlement.............	163	382	—	—
During pleasure of government........	12	1	—	6
	182	406	1	6

"In Burma the number of animals grazing by right under settlement is the number for which rights were given. Only a very small pro-

portion of the animals for which rights have been given have, up to the present date, been grazed in the forests.

"The corresponding figures for the Central Provinces are as follows:

	Buffaloes	Cows and bullocks	Goats and sheep	Other animals
At full rates	260	730	256	4
At privileged rates	104	1,622	3	——
By right under settlement	——	——	——	——
During the pleasure of government	6	259	1	——
Total	370	2,611	260	4

"The forests in the Central Provinces are deciduous, and do not yield large timber. The population is 139 to the square mile, compared to 55 in Burma."

In 1918-19 there were 247 square miles of plantations (chiefly of teak and sissham) yielding from nine to eleven dollars net per acre per year. These plantations were planted waste land (in large blocks) rather than small areas within existing forests. The exports and imports of forest produce are as follows:

The volume in million board feet, in the case of timber, and the volume in tons of 20 cwt. in the case of other products, as well as the value in dollars of the forest products exported during 1918-19 is shown in the following table:

Nature of forest product.	Tons of 20 cwt. or 1,000 board feet	Value, thousands of dollars	Percentage of total value
Caoutchouc (rubber)	6,236	8,344	36.9
Lac (principally shellac)	11,955	9.828	43.4
Cutch and gambier	2,906	386	1.7
Myrabolans	41,194	1,644	7.3
Cardomums	286	258	1.2
Teak	28,838	1,996	8.8
Sandalwood	104	52	0.2
Other timbers	4,475	120	0.5
		22,628	100.0

A little under 98 per cent of the lac exported consists of shellac. Lac, like rubber, is a crop and not a natural forest product. Most of the lac is grown outside the Government forests, and very little

forest revenue is derived from this minor product. The value of the sandalwood lies in the sweetly scented oil it contains.

The average annual imports and exports of timber for the five years ending 1918-19 are as follows:

	Exports		Imports	
	Board feet (millions)	Value in dollars f. o. b., thousands	Board feet (millions)	Value in dollars c. i. f., thousands
Railway sleepers (various species)	....	....	9	288
Deal and pine timber	....	....	10	564
Jarrah timber	....	....	2	75
Teak timber	17.5	1,517.5	13	877
Other timber	2.2	66.0	19	722
Total	19.7	1,583.5	53	2,526

In addition to the above, tea chests to the value of nearly one and a half, and matches to the value of nearly 7 million dollars were imported.

Estimate of the annual increment of the timber and fuel in Government forests in India. The area of forests under the control of Government is 126,309 square miles. Taking the annual increment of timber producing woods to be 15 cubic feet per acre, a very conservative estimate, total gross annual increment in the log from this area amounts to 1,212.5 million cubic feet. This is only three and a half times the present yield.

Allowing for the following loss from fire, and waste, decay, etc.:

	Cubic feet
Fire	14,000,000
Waste and decay	21,500,000
Total	35,500 000

the net annual increment of the forest of India, under the control of Government, is 1,187,000,000 cubic feet solid in the log.[1]

[1] Two cubic feet in the log = 1 cubic foot converted.

PRESENT DAY FORESTRY IN AUSTRIA

By F. S. Baker

Forest Examiner, U. S. Forest Service

More or less conflicting stories come to us in the newspapers and magazines of conditions within the area embraced by the old Austro-Hungarian Monarchy. They have to do largely with political situations and general conditions, and on reading these items we often wonder how forestry and foresters are faring in that country. The "Wiener Allgemeine Forst-und Jagdzeitung" is a little weekly newspaper published in Vienna, dealing with forestry and the lumber trade, which affords a glimpse into the forest conditions of Austria and the surrounding States, and shows the questions that are worrying present day Austrian foresters.

Judged by the amount of space and prominence of the articles, the matter of taxation is the most interesting subject. Not only are the heavy income and other taxes bearing heavily upon foresters as individuals, but certain phases of the taxation system are having a pronounced effect upon forestry and forest utilization. As is usual today in most countries, the income and property taxes are arranged on a sliding scale so that the wealthy and large property holders are taxed much more heavily than the poor. This hits the big private forest estates very hard and it is doubtful if they can stand the burden. It means mortgaging the property in order to pay present taxes in many cases, or selling the property in small parcels to persons of small income whose tax rate is low. This means that handling the area as a forest unit becomes impossible and large scale economical exploitation has to stop, both definite steps backward. Other factors also tend the same way. To the forester, a Republic with Socialistic leanings, as Austria now is, ought to socialize the forest lands, take them all over and manage them as a great single unit for the good of the State at large. To the peasant and small land owner, Socialism as applied to the forests means that each ought to have his own little share of the State's forest land and that the great single holdings of private individuals, companies, and the old Crown Forests ought to be at once

broken up and equally distributed. These diametrically opposed views lead to a number of articles presenting the socialization of the forests in different lights.

Popular ideas of Socialism and Republicanism and "liberty" coming in with the fall of the Imperial form of government have led to a widespread lack of observance of forest and game laws, especially the latter. Numerous notices appear dealing with the frequent and general infringements of game laws, and one writer strongly urged a revision of laws allowing forest officers to shoot any man found in the woods with a gun who refuses to halt when commanded—at present he may fire only in self-defense when his life is threatened by the poacher. Much of this illegal hunting is perhaps due to the scarcity and high price of food, though this cause is infrequently mentioned.

Transportation is poor and production is low, so prices remain high for all forest products. Large lumber concerns fear to go ahead on account of high prices and taxes and some of the best timber lands are being subdivided and parceled out to small owners. The firewood shortage is extremely acute, particularly in the neighborhood of Vienna and in the region of southwest Austria that lay behind the Austrian lines on the Italian front during the war and was cut over exceedingly heavily for the army. In any forests near cities, all regulations were necessarily suspended and an uncontrolled cutting for firewood took place last winter, spoiling all the silvicultural and management plans for years to come.

In the higher mountains, grazing has become much more intensive and has given rise to many articles and notes pointing to the disastrous effects of over-grazing, which is particularly unfortunate at this time as Austria must develop waterpower. It is apparently agreed on all sides that her best chance for economic development, lies in the use of the mountain streams for hydroelectric power.

The picture is not entirely dark, however, by a good deal. The change in form of government itself seems to have had at least one good effect. As it used to be the highest officers of the forest administration were jurists and not technical foresters. For years the technicians had beat ineffectively upon this wall of lawyers in an endeavor to present to the Imperial assembly (Budget Committee) their plea for technical foresters in all positions. The lawyers, well intrenched in their superior position, were always able to prevent this desire of the foresters. With the change in form of government, many of the higher

officials went out of government service and the jurists, as a class, lost much of their prestige. Favorable action was expected in 1920 leading to the employment of forest technicians in all offices of the administration.

Forest education is in a relatively flourishing condition. Whereas in the old Austro-Hungarian Empire a few schools could serve the whole large country, now each separate subdivision needs schools. The agitation for forest schools is especially strong in Czecho-Slovakia and the sentiment has been crystallized in a petition presented to the government to take over a small private school and make it a forestry branch of the Technical School at Prague. While it is generally conceded that forest schools independent of all other institutions are the most desirable, the present poverty-stricken condition of the country necessitates either going without forest schools or making them branches of existing establishments, thus utilizing at least in part, buildings and faculties already in existence. In Jugo-Slavia a forest academy has been established at Saravejo, and in Poland and Hungary similar movements are under way. It seems possible that these small States may become over-schooled if all the proposed plans are carried out, causing an over-production of trained foresters, together with small enrollments in the various schools.

In the Bosnia-Herzegovinian Karst region the reforestation of barren lands seems to be proceeding in an uninterrupted manner, despite the transfer of the land from Austrian administration to Jugo-Slavia, which is dominated by what used to be Serbian interests. Two articles, one on nursery fertilizers and the other on rabbit damage, lead to the inference that the work is proceeding probably just as before the war, although nothing definite is said on the matter. On the whole it seems that forest administration is less badly affected than we would suppose from our general news dispatches from Austria.

There are numerous little sidelights of particular interest to Americans scattered through the news items pertaining strictly to Austrian affairs. For example, in one issue is an illustrated article on American hickory, and elm and ash taken from American Forestry, in many parts being a close translation. Again in an article urging more tree planting in Austria, we find the French plantations held up as a shining example just as they are in America, but also we find ourselves held up as an example to Austria. Our Arbor Day is explained in detail and the Forest Service plantations in Nebraska are cited as notable

achievements. Another little note announces the formation of an American company with a capital of $125,000 in Pressburg (Czecho-Slovakia) for the manufacture of furniture and parquet flooring.

Austria has lost her greatest forests by the breaking up of the monarchy and cessions to Italy. Poland and Czecho-Slovakia are now far more important as timber producers. Nevertheless the cause of forestry is not being forgotten, but indeed has become even more important since the remaining stands have an increased value not only for themselves, but for their watershed protection. No matter what our newspapers say Austria is going to do politically, turn back to a monarchy or go on to a Bolshevik state, her forest policies appear to rest in good hands and we may expect the continuance of the best technical forest administration that is possible under the financial and economic conditions existing there.

SUGGESTION FOR A NATIONAL ARBORETUM

By W. W. Ashe

The Southern Appalachian region offers the best natural possibility for the selection of a site for a National Arboretum. The great number of native species,[1] the variety of forest types and the great range in elevation which occurs within a relatively small area, are conditions which combine to make this a favored section for such a choice. There is at present, within this region, no adequate Arboretum or Botanical Garden in which both native species and the forms from other regions which will thrive in the Appalachians can be assembled under more or less normal environment for comparison and study as living plants. The establishment of an Appalachian Experiment Station suggests the possibility of an Arboretum as an adjunct to it. It would be one phase of the work of an Experiment Station which could be popularized, although the ends which are sought might require highly scientific methods. The plantings could be so placed as to form harmonious parts of the natural forest, adding to it variety and charm, rather than in the monotony of formal arrangement. Such an Arboretum could be developed along roads with a view to securing accessibility, and should follow a scenic route to some point of paramount interest to obtain what the landscape architects call "circulation."

The ideal location in the entire eastern forest region would be on the eastern slope of the Blue Ridge at the head of the Catawba River, crossing the Black Mountains at Mitchell's Peak and descending to the headwaters of Cane River. This would touch the Asheville resort district with its half million annual visitors. The altitudinal range here exceeds 5,000 feet, and lies within three life zones. A road could be so located without devious route as to traverse not less than fourteen forest types, beginning in the Carolinian zone below Old Fort in the gums and ashes of the alluvials, passing through the Castania

[1] Among the genera richest in woody species may be mentioned *Quercus* with 17 and one variety; *Hicoria* with 8 species and two varieties; *Betula*, 4 species and one variety; *Pinus*, 5 species; *Populus*, 3. *Magnolia*, 4; *Prunus*, 8; *Rhus*, 8 species and one variety; *Malus*, 6 species and two varieties; *Amelanchier*, 6 species; *Crataegus*, 51 species and varieties; *Acer*, 8 species and two varieties; *Fraxinus*, 6 species. *Tilia*, 4 species; *Salix* 5 species; and *Ulmus*, 3 species.

zone and culminating in the spruce and fir of the Canadian zone at nearly 7,000 feet, and then descending through the beech-birch-maple, hemlock, and yellow poplar types on the northwest slope. Such a route, which would be almost entirely within the boundaries of a National Forest, would be highly scenic, giving at many points magnificant vistas across the foothills far out into the Piedmont of the Carolinas; or across the Unakas into Tennessee. Of scarcely less allurement would be the floral tapestry of woodside and mountain meadow. With the unfolding buds appear the dwarf locusts. The vernal flowering rhododendrons [2] and azaleas,[3] with the gorgeous display of white, rose and flame-colored flowers are followed by summer species, and these are succeeded by the yellows and purples of many herbs which usher in the crimson and orange tones of autumn.

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[2] There are 3 species of *Rhododendron* and one variety which occur abundantly along the proposed location. The earliest flowering of these is *R. carolinianum* var. *margarettae*, which differs from the type chiefly in having white or nearly white and not rose-purple flowers. This variety is very abundant above Old Fort on the head streams of the Catawba River.

[3] Of the species of Azaleas in the Eastern United States, seven, with 5 varieties, occur in this immediate region. *Rhodora vaseyi* (Gray) n.c. Rhododendron vaseyi Gr., Proc. A. A. 15, 48. *Tsutsusi calendulaceum* (Mx) n.c. Azalea calendulacea Mx., Fl. 1, 151. *T. calendulaceum f. croceum* (Mx.) n.c. Azalea c. *B* crocea Mx., Fl. 1, 151. *T. calendulaceum f. aurantium* (Lodd.) n.c. Azalea coccinea aurantia Lodd., Bot. Cab. 13, t. 1255. *Tsutsusi nudiflorum* (L.) n.c. Azalea n. L. Sp. Pl. ed. 2, 214. *T. n. glandiferum* (Port.) n.c. Azalea nudiflorum var. g. Porter, Bul. F. Cl. 27, 508. *Tsutsusi roseum* (Loiseleur—des Longchamps) nc. Azalea rosea, Loiseleur—des Longchamps, in Duh., Traité; ed. 2, 5, 224. *Tsutsusi canescens* (Mx.) n.c. Azalea canescens Mx., Fl. 1, 150. *Tsutsusi canescens candidum* (Small) n.c. Azalea candida Small., Bull. Tor. Cl., 28, 360. *Tsutsusi viscosum* (L.) n.c. Azalea viscosa L., Sp. Pl., 1, 151. *Tsutsusi viscosum glaucum* (Ait.) n.c. Azalea viscosa glauca Ait., Hort. Kew. 1, 203. *Tsutsusi viscosum montanum* (Rehd.) n.c. Rhododendron v. montanum Rehd., Azal. 164. *Tsutsusi viscosum* f. *coerulescens* (Rehd.) n.c. Rhododendron f. Rehd., Azal., 165. *Tsutsusi arborescens* (Pursh.) n c. Azalea arborescens Pursh., Fl. 152. *Tsutsusi arborescens richardsonii* (Rehd.) n.c. Rhododendron arborescens var. Rehd., Az. 168. In addition to these which occur in this region a number of others can probably be grown without difficulty. Among these might be mentioned the following: *Tsutsusi californica* (T. & G.) n.c. Azalea californica T. & G. *Tsutsusi speciosa* (Willd.) n.c. Azalea speciosa Willd., Berl. Baum. Ed. 2, 49. *Tsutsusi austrinum* (Small) n.c. Azalea austrinum Sm. Fl. Ed. 2. 1356. *Tsutsusi atlanticum* n.c. Azalea atlantica Ashe, Bul. ch. Mus. 13, 26. *Tsutsusi neglectum* n.c. Azalea neglecta Ashe, Bul. Tor. Bot. cl., 47, 581. *Tsutsusi oblongifolium* (Sm.) n.c. Azalea oblongifolia Small, fl. 883. *Tsutsusi serrulatum* (Sm.) n.c. Azalea serrulata Small, Fl. 883. *Tsutsusi serrulatum georgianum* (Rehd.) n.c. Rhododendron s. var. Rehd., Azal. 156. *Tsutsusi viscosum nitidum* (Pursh.) n.c. Azalea nitida Pursh, Fl. 1, 153. *Tsutsusi viscosum tomentosum* (De Cour.) n.c. Azalea tomentosa De Courset, Bot. Cult. Ed. 3, 336. *Tsutsusi viscosum hispidum* (Pursh.) n.c. Azalea hispida Pursh, Fl. 1, 154. *Tsutsusi viscosum aemulans* (Rhed.) n.c. Rhododendron v. var. Rhed., Azal. 165.

Within the limits of 50 miles of such a route there occur 124 indigenous arborescent species, and 12 varieties; and of shrubby forms 192 species and 9 varieties, many of them endemic. Suitable habitats could be found for most plants of the Carolinian zone to its very southern termination in the Edwards Plateau in Texas, and in western Oklahoma, and for many species from other parts of the Atlantic drainage so as to augment this naturally rich collection.

The economic benefits, however, which would result from the assembly and study of native forms would probably be slight compared with the advantages which might follow the introduction of foreign species from corresponding life zones, especially from eastern Asia, the silva of which has many affinities with that of eastern America. Nature has already worked out for this continent what are the dominant species best adapted to each forest type, and it will probably be necessary to secure from similar life zones on other continents species which might prove superior to the native ones. Southern China, the mountains of northern Siam and Indo-China, the northern and eastern slopes of the Himalayas and the mountains of Formosa and Hondo offer the possibility of valuable species; species for such uses as to replace on highly acid and sub-peaty sites chestnut now being exterminated by a Japanese fungus; or to supplement the inferior Spanish oak and low grade black pine. More than 20,000 persons have yearly ascended the Black Mountains, and many of these visitors in the future would carry away with them a lasting impression of such an Arboretum. It would combine an appeal to those in quest of recreation; be of high interest to such as desire to study a richly varied flora, and a matter of supreme economic importance.

REVIEWS

Twentieth Engineers (France, 1917–1918–1919). Dimm & Sons Printing Co., Portland, Oreg.

Perez Simmons, Alhambra, Calif., and Alfred H. Davies, Portland, Oreg., the editors, and Shelby L. Davies, Portland, Oreg., the business manager of the preliminary history of the men of the Twentieth Engineers, are to be congratulated upon their intimate log of these battalions who have "drab and aching memories of monotonous drudgery," aimed at helping win the war. These men were not permitted to take their stand in the front line trenches and face death because they were needed to produce wood products for the A. E. F. and in co-operation with the French and British Forestry Corps. On November 11, 1918, the Twentieth Engineer organization in France comprised 290 officers and 11,586 men, with Forestry Service companies of 61 officers and 6,422 men. There were also Engineer Service Battalions attached to the Twentieth Engineers comprising 9 officers and 751 men. Quartermaster units engaged upon fuel wood projects in the advanced section under the technical supervision of the C. & F. included 146 officers and 10,700 men. These units delivered the goods and were perhaps the most efficiently organized of any technical branch in the S. O. S.

Perhaps it would have been more fitting if the names of H. H. MacPherson and Wilfred A. Fair, the two men "killed in action" had been placed on a special page in the front of the book. But it must be recalled that at least 91 men were lost on the Tuscania which in effect was a naval action in the face of the enemy and there is no one who can say today what deeds of heroism were performed by one or more of these men who went down before a German submarine. Moreover, Corporal Charles J. Cumiskey, who "was recommended for a Distinguished Service Medal as a posthumous reward for service in serving the sick men in the (flu) epidemic which claimed him as a victim after he had exhausted his strength in saving the lives of others," certainly could take his place as one of the heroes of the Battalion. The reviewer would be proud to subscribe to a monument to the men of the Forestry Battalions who lost their lives in the Great War and

perhaps such a monument commemorating foresters and lumbermen could fittingly be placed on one of the National Forest peaks in the Western United States (as, for example, the San Francisco Mountain Peak in Arizona).

This little history fittingly emphasizes the services of the men who underwent the drudgery as contrasted with the officers who without doubt led easier lives and received the tangible rewards earned by the hard work of these faithful soldiers. The book contains a well deserved tribute to Captain Howard Y. Williams, Regimental Captain, who unquestionably had the confidence of the men of the regiment and who was clearly a friend to the "unsung, uncited bucks of the Twentieth Engineers."

The biggest regiment in the world's history contained perhaps the finest lot of workmen ever assembled on one job at a dollar a day and it is entirely proper that their work should be heralded ahead of a technical story of what the men higher up accomplished at their desks. In reading this history, however, the outstanding fact of the war and of American participation—namely, *victory attained*—should not be clouded by the citation of hardship and inefficiency, lack of equipment, early lack of organization, tough work on burned timber after the armistice, repair of roads, and the technical inefficiency of many of the officers in charge. Backed up by fine sets of photographs, the editors have presented a breezy, interesting statement of the Twentieth Engineers and related organizations (including the Tenth Engineers which beat the Twentieth to France). The First and Second Battalions of the Twentieth sailed on November 11, 1917, and the last Battalion sailed for home on July 5, 1919.

From a historical standpoint the most interesting story is that of the Sixth Battalion, ordered organized December 7, 1917, which sailed on the Tuscania on January 23, 1918, and probably few realize they "discovered that the boat tackle in many cases to be fouled or rotted and unfitted for use" and that the Tuscania floated for an hour after the last survivor had left the ship; or that "out of more than sixty men in one of these boats there were but eight saved"; or that "a few swimming alone and helpless were left." One cannot help but feel thankful that the German submarines were not more efficient than they were if men were hurried to France in ships ill-prepared for submarine attack.

A minor criticism is that the book is probably the only volume of its kind ever published without any page numbers. But such a minor defect is obviously of small importance compared with the historical value of the volume, although it might have increased the interest of the men if a complete roster had been published in the appendix.

T. S. W., Jr.

Swedish Forests: Lumber Industry and Lumber Export Trade. By Axel H. Oxholm, Trade Commissioner. Department of Commerce, Bureau of Foreign and Domestic Commerce. Special Agents Series, No. 195; 281 pp. Price, 75 cents.

Sweden occupies the leading position in the lumber world, according to the report, not on account of the quality produced, but on account of scientific forest management and efficient manufacturing and selling methods. Fifty-one per cent of the country is comprised within the 55,000,000 acres of forests, of which 13,000,000 are public. Because of the realization in Sweden of the supreme importance of forests in the national life, stringent laws with regard to cutting have been adopted. A Swedish forest expert is quoted as saying that "the position of Sweden as an independent nation and as a civilized country is contingent upon the existence or non-existence of forests."

During normal years before the war the exports from Sweden of forest products aggregated $90,000,000, or 44 per cent of the total exports. The Swedish government accordingly considers the perpetuation of the forests of such vital importance that no one is allowed to endanger the future of the timber stands by reckless exploitation for the sake of immediate profit. This point of view is so generally accepted that no difficulty has been experienced in connection with the government's control of the cutting of timber on private lands.

Because the cutting is thus restricted and it is a matter of necessity to get the utmost value out of the cutting permitted, particular attention is paid in Sweden to the elimination of waste in the forests. The high stumps prevalent in America are unknown in Sweden. Top logs, too, are not left in the woods. The closest possible attention is paid not only to price but to the utilization of waste products in logging operations.

Strict laws govern the management of the Swedish forests, varying only with difference in climate. These laws have to do with cutting

and with the forestation of cut-over lands. Lately a law has been enacted to prevent the cutting of immature trees unless such cutting is necessary in order to improve the condition of the forests. Reforestation has been carried on in Sweden by both public and private enterprise. The forest owners regard it as a commercial and paying proposition.

The cutting of saw logs is carried on only during the winter in order to prevent deterioration in the quality of the logs through discoloration. Stumps seldom exceed three inches in height. The utmost care is given to the cutting of suitable log lengths and sizes so that the best possible results may be obtained when the logs are cut into lumber. No logging machinery of any kind is generally used in Sweden, though American tractors have lately been introduced into that country for hauling logs. The logs are loaded on sleighs and taken on the snow to the nearest waterway, where they are piled on the river bank or on the ice ready to be dumped into the water in the spring. The floating of logs is usually carried on by a number of floating associations established by log owners, the logs being floated for joint account.

Cheap transportation from the forest to the mill accounts for the fact that Sweden can effect a very close utilization of its forest products. Top logs, even down to one or two inches in top diameter, are bunched and strapped with steel wire and floated to the nearest charcoal plant, where they are converted into charcoal. The saw logs are on the average from 6½ to 7 inches in top diameter and average in length from 17 to 18 feet. The logs are generally barked in the woods, in order to prevent an accumulation of bark in the river and at the mills, which would seriously hinder floating.

Through long experience in lumber manufacture the Swedes have produced a type of machinery especially adapted to the Swedish conditions. Following the increased value of stumpage, their machinery has been constructed with a view to accepting the largest possible saving in raw material. The gauge of the saw blade is always very small. All large mills are equipped with gang saws. Only the smaller mills have circular saws. The gang saws give the best results because they saw lumber to exact sizes. Careful manufacture is the principal feature of Swedish sawmills. The green lumber is given a certain excess to provide for shrinkage. After it has been seasoned it is exactly the required dimension. All guesswork is eliminated from the Swedish sawing schedules. The method of obtaining the most profitable

dimensions of lumber is calculated with scientific exactness. Particular attention is given to edging the lumber so as to obtain the largest possible sizes, because the price of lumber is determined by the size rather than by the thickness. The lumber is not trimmed in the mill. It is cut to almost any dimension, according to English measurement. Metric measurements are seldom used in lumber for export. The lumber is edged on the half inch and in thickness is cut to almost any size, but usually on the quarter inch.

The actual waste in the Swedish sawmills is negligible. Even the smallest piece of lumber is turned to some use. If too small to produce laths, broom handles, box shooks, etc., it is converted into charcoal or pulp. The sawmills are generally run in connection with pulp factories, and many mills also operate planing mills or box factories. The planing mills are equipped with Swedish planers, which show some excellent features in the way of saving material and perfectly smooth products. The operation of Swedish box factories, planing mills and sawmills is based on a skillful utilization of the raw material. The profit often hinges on the thickness of the saw blades used.

Swedish mills season their lumber in the open air and it is never shipped unless air dry. This seasoning requires from two to seven months, depending upon the season and the location. The lumber is trimmed before shipment. The trimming is effected on the odd and even foot. The mill ends are carefully collected and retrimmed. Then it is sold to local box factories or exported. Lately the Swedish lumber merchants have combined in selling for export. The Swedish laws permit combinations of manufacturers for these purposes. The Swedish lumber men have taken advantage of this condition and have been in a position to obtain such prices as would give them a reasonable return on the investment. The prices of lumber have increased very materially since the war, as have the prices of stumpage and labor. The position of the Swedish lumberland is now considered exceptionally good because the war and the high prices have enabled them to better their condition. The export is two billion feet annually.

The report brings out three principal phases of interest to American readers. First, the measures taken to preserve the forests and eliminate waste in lumber; second, the inferior character of Swedish lumber; third, that by combination of all Swedish lumbermen in the export trade and superior selling methods, they manage to market their inferior lumber for the same price as the greatly superior American lumber.

Studies in French Forestry. By Col. Theo. S. Woolsey, Jr., with two chapters by Col. Wm. B. Greeley. John Wiley & Sons, New York. 550 pp. Ills. 1920. $6.

The book is one with which every American forester should be familiar. It draws innumerable valuable and interesting comparisons between French and American forestry. It will prove especially interesting to the many American foresters who were with the American Expeditionary Forces in France, who often had questions arise with respect to French forests, the answers to which were not then readily available. To these men it will also be a pleasant reminder of an inspiring field in which they formerly worked. Many American foresters will visit Europe in the future. They will visit France, of course, for many other reasons than forestry, although forestry will be more than a sufficient reason. To an American the study of French forestry is especially worth while because of its relative simplicity, its direct attack on matters of practical importance, its ignoring of theoretical complexities. The American forester, like the French and unlike the German, is an individualist.

The book discusses the development and practice of forestry in France in great detail. It is of far greater value to an American than a translation of a French book, for Woolsey, seeing with the eyes of an American, points out those many features of special interest, which are in contrast to our conditions, or which serve as valuable lessons to us.

In America, we now have before us the problem of utilizing 10,000,000 acres of sand plains in Michigan, formerly forested, but now a waste. Millions of other acres of cut over and burned sand plains in the southern States must also receive attention. Years ago, France had a similar problem in the Landes along the southwest coast. The Landes situation was further complicated by a strip of dunes approximately 4 miles wide and 120 miles long which were moving inland and devastating the country as they moved. The account of the fixation of these dunes and their reforestation and also the reforestation of approximately two million acres of waste sand plains lying behind them, telling how an economic desert was converted into one of the most prosperous regions of all France, is undoubtedly one of the most interesting stories to be found in all the world's experience with forestry. Woolsey shows in detail how the problem was attacked both as to its economic features and as to the technical conduct of

the work. The French government provided for the reforestation of the dune area by requiring that private owners do the work or allow it to be done by the government. Nearly all of it was done by the Government, but much of the area was returned to the original private owners when the income from the forests equalled original cost plus compound interest. More productive lands, approximately two million acres in extent, lying further inland are now valuable and highly productive private forest properties. It is not clear from the account whether these areas were reforested by private initiative or by the government. It is hoped that Woolsey will discuss this point further some time in the future.

Another epic of French forestry is the work of torrent and erosion control in the Alps and Pyrenees. By going through the bitter experience of having part of the forest cover destroyed, France has quite thoroughly learned the immense importance of maintaining forest cover on steep slopes. The forest destruction was followed by disasterous floods. For the past sixty years, France has slowly, painfully and at great expense been re-establishing forest conditions. Here are excellent lessons for regions like Southern California where erosion is so destructive and water so valuable.

The economic damage done to the French people by unrestricted cuttings on private lands in the mountains, in the sand dunes, and in other places has been recognized for many years and is controlled by law. Forests of strategic value for national defense near the frontiers and forests which are of importance in regulating stream flow must be maintained by the private owners. French statutes provide that private owners must maintain their forest lands as such unless permitted by the government to abandon their use for forest purposes and to convert them to other uses. However in the face of the fact that France finds it necessary to import a large proportion of the timber which it requires, and although urged to such action, the French Chamber of Deputies has never been willing to pass laws requiring private timber land owners to raise crops of timber, the main purpose of which would be to provide for future timber supplies.

Col. Greeley, qualified above all others, gives a most interesting history of the work of the American Forest Engineers. It is hoped that some time he will tell this story in much more detail.

A small number of mistakes and omissions slightly mar the value of the book. On page 20, for instance, line 9, there are mistakes in the conversion of Centigrade to Fahrenheit temperature readings. On

page 48, the fourth line from the bottom should read "should be divided by 3.5 and figures in the fuel column *multiplied* by .277." On page 93, the figures in the table state ratios rather than quantities as indicated in the table headings. However, these unimportant difficulties are such as almost inevitably creep into a book of the magnitude of this one.

The book perhaps has its greatest value for reference purposes for those who are studying some special subject such as the practice of silviculture, regulation, law, finance, administration, or the like.

We have reached a stage in the development of American forestry when it is decidedly stimulating to study the progress made by a nation which has had a progressive forest policy for many years longer than we have had. Woolsey has made it possible for the American forester to make such comparisons with a country with which we are in close sympathy and with which, above all others, a great number of Americans are somewhat acquainted as a result of the war.

It is hoped that Woolsey will add to the valuable service which he has rendered to American forestry by similar studies for other countries such as Sweden, Finland, Russia, Germany, Austria-Hungary, and Japan.

D. T. M.

The Life History and Control of the Pales Weevil (Hylobius pales). H. B. Peirson. Bulletin No. 3, Harvard Forest, Petersham, Mass., 1921.

The preliminary work of the reviewer on the damage to coniferous seedlings on or near freshly cut-over lands in New England has been ably extended by Peirson on the Harvard Forest. Trained in entomology, and working under the direction of a practicing forester, he conducted an extensive series of field and laboratory tests that are of interest to all field men who work within the natural range of *Pinus strobus*. The results of these studies are now available in the form of a concise, well-illustrated, and well-written pamphlet.

The *pales* beetle, like its near relative, *Hylobius abietis* in Europe, makes it impracticable to plant cut-over pine land for two or three years after the removal of the old stand, and kills very large percentages of the natural reproduction on or near such areas. Definite records of losses in natural reproduction as high as 80 per cent in the two years following cutting are given. The beetles are attracted from long distances to freshly cut stumps, log piles, or freshly cut lumber.

Even a single small stump in a gray birch clump attracted enough beetles to damage eleven out of fourteen seedlings within a twelve-foot circle during two weeks. A strongly developed sense of smell and an ability to fly considerable distances have been thoroughly demonstrated.

Peirson recommends preventive measures of control, such as charring the stumps by burning the slash over them, turning logs to dry out the bark in which eggs or larvæ are present and refraining from cutting old stands until nearby reproduction has reached at least a height of three and a half feet. Experiments are being continued to determine whether the beetles can be reduced to harmless numbers on a cut-over area during the first year by eliminating their preferred food. Obviously, there is opportunity for more study, but the work done already is of value in showing foresters the very real danger from this beetle in applied silviculture in the eastern white pine region. E. E. C.

Live Stock Grazing as a Factor in Fire Protection on the National Forests. By John H. Hatton, Assistant District Forester. U. S. Department of Agriculture, Department Circular 134, September, 1920.

According to Hatton, grazing keeps fires from starting and from spreading and makes them less destructive. On the other hand, there is injury to ground, soil and water conditions, and to the range itself. Hatton, who is a grazing specialist, makes a strong statement of the benefits from grazing, particularly in the example that he gives of the Wenatchee National Forest in Washington where sheep driveways stopped three large fires in 1909 and 1910. He argues for the timely use of present ranges, for the utilization of unused grazing lands through development, a study of the class of stock to be grazed where there are fire protection problems, and the projection of driveways and trails as a means of fire-line construction, the actual overgrazing where fire damage is particularly dangerous, and the closer co-operation of live-stock employees in fire prevention. T. S. W., Jr.

NOTES

Greeley Resigns From Directorship in the American Forestry Association

[Although Col. Greeley requested that the letter printed below be published in the American Forestry Magazine, it never appeared there. The letter is therefore given publicity in the Journal.—Ed.]

U. S. Department of Agriculture
Forest Service
Washington

March 5, 1921.

Mr. Chas. Lathrop Pack,
American Forestry Association,
1214 Sixteenth St., Washington, D. C.

Dear Mr. Pack:

I hereby tender my resignation as a Director of the American Forestry Association. I am taking this action because of my radical disagreement both with the change in organization of the Association accomplished at the February meeting and because of the manner in which this change was effected.

The American Forestry Association has stood to me as the agency best equipped to lead, direct, and give effect to the sentiment in the United States in support of forestry. The strength of the Association has lain fundamentally in its right to speak with authority as representing a considerable body of American people. That right the Association has now forfeited. From a representative organization, responsive to the sentiment and judgment of its members, it has become a body deliberately organized for perpetuating control of the Association and its activities by a small group of men regardless of how that group may or may not represent the sentiment of the membership. It is my conviction that no gain which the Association may make in material things as the result of this change in its organization can possibly offset the loss of its authority to speak as a representative of a large body of American sentiment, democratically organized and conducted.

My second objection is based on the fact that this radical change in the character of the Association, the most radical since the organiza-

tion was founded, was put through at the instance of the present administration without giving the membership of the Association any adequate opportunity to pass upon its merits and to adopt or reject it as it saw fit. The Association was not organized for the purpose of giving a small self-perpetuating group of men authority to speak in the name of its 14,000 or 15,000 members or to use funds raised through the current subscriptions of these members as it sees fit. It was organized to give effective and democratic expression and leadership to the consensus of conviction by its membership on forestry measures requiring public action. If the members of the Association desired to change the character of their organization, well and good; but they had no opportunity to pass upon it. This fundamental change was made by a negligible fraction of the membership with no opportunity for the rank and file of the Association members to judge the merits of the proposal and to accept or reject it as they might desire.

Under these circumstances, I can not assume any responsibility, however nominal, for the future conduct of the affairs of the Association; and my resignation as one of its Directors is the only course open. I desire to have my position in this matter clearly understood by the members of the American Forestry Association by and large, and therefore request that this letter be published in the next issue of the magazine.

Very sincerely yours,

W. B. GREELEY,
Forester.

H. H. CHAPMAN RESIGNS FROM LIFE DIRECTORSHIP IN THE AMERICAN FORESTRY ASSOCIATION

As the May issue of the JOURNAL goes to press the following telegram was received from Prof. H. H. Chapman, who is now on field work at Urania, La.:

Presented my resignation to the Board as life Director on May 12—the first meeting the Board held since election. There remained certain duties to perform in my capacity as Director which had not been completed before and therefore prevented my earlier resignation. I am still retaining my membership in the Association. Urge all members to co-operate with the temporary committee, of which Henry S. Graves, 1731 H Street, Washington, D. C., is Chairman, and Harris A. Reynolds, 4 Joy Street, Boston, Mass., is Secretary, in securing proper reorganization of the Association.

H. H. CHAPMAN.

"Light Burning," as Viewed by Australian Foresters

In the December, 1920, number of the *Australian Forestry Journal* there appears an article on page 373, entitled "Fires in Eucalypt Forests." Some of the material in this article has a very familiar sound. It states, for instance:

"There is, however, a specious contention which has become fairly universal in Australia and has even found official recognition. It is said that the only way to control the bush fire is to run a creeping ground fire through the eucalypt forest as frequently as possible, and thus prevent the possibility of a big blaze damaging the forest. This end may be obtained, but at what cost? Have we any reason for supposing that the food material of trees in Australia differs radically from the food material of trees on the continent of Europe? European experience has proved conclusively that leaf mould and litter on the floor of the forest is indispensable to the successful growth of a forest, yet it is common practice to despise it utterly in Australia, and rule it out as of no account. To take a single instance: In the South of France Pinus *pinaster* was found to grow successfully on bare white sand which had been temporarily fixed by scattering brushwood and weighting it with spadefuls of sand. The cluster pine grew and developed into satisfactory trees yielding a valuable return of turpentine and timber. Happily, the trees were too inflammable and the French forester was too well trained to eliminate fire risks by burning up the needles and branchwood as they fell. Instead, they established firebreaks and built watch towers so that serious fires are practically unknown. The beneficial result is now being felt, for the second crop of pines is growing more rapidly and developing into a better class of tree than the first. This is solely the result of fire protection and preservation of leaf and branch litter cast by the trees."

In speaking of timber in the Jarrah belt of western Australia the article goes on to say:

"Recent measurements show that these are developing at a very much slower rate than has been believed in the past, and it can be quite logically postulated that repeated firing of the jarrah bush, whereby the top soil is baked hard and every vestige of humus destroyed, is slowing up the rate of growth of the jarrah. The cry that it is impossible to prevent and control fires in a eucalypt forest, whether it be stringy-bark, ironbark or jarrah, *is the cry of a small man faced with a big problem.*"

Is it out of place to ask here whether foresters in the United States who are faced with the same problem of fire control in the southern United States are going to plead guilty to the indictment in the last sentence of this quoted article?

Another Method of Cutting Christmas Trees

Editor, Journal of Forestry:

I was very much interested in the article that appeared in the Journal for March under the title "Christmas Trees Cut Without Destroying the Parent Tree." It happens that there is a student in one of my classes who has cut Christmas trees on a plantation for several years past. The plantation is situated in Monroe County, Pa., and consists of spruce and balsam fir. I am informed that the method of cutting these trees is invariably to leave one branch of the lowest whorl of branches so that the stand may continue to be productive almost without interruption. During the past 20 years as many as seven trees have been taken from some of the stumps. In fact, the rule is never to cut the trees below the lowest whorl unless a thinning is necessary.

Lawrence W. Smith,
Instructor in Forestry.

Department of Forestry,
State College, Pa.

Revenue From Indian Forests

The Inspector General of Forests has furnished the following official statement of revenues, never before available to American foresters, for the period 1909 to 1918: (Three rupees equal one dollar.)

	1909-10	1910-11	1911-12	1912-13	1913-14
Gross revenue	$8,675,265	$9,135.151	$9,685.786	$10,403,266	$11,100,515
Expenditure	4,976,885	5,081,341	5,648.855	5,769.270	5,847,818
Net revenue	3,701,713	4,053.810	4,036.931	5,000,666	5,252,663
Total area in square miles	224.551	243.478	242,960	238.923	245,612
Area under forest W. plans	49,421	50,183	50,892	51,722	53,926

	1914-15	1915-16	1916-17	1917-18	1918-19
Gross revenue	$9,903,261	$10,372,122	$12,353,977	$13,656.419	$15,606,077
Expenditure	6,068,817	6,197,538	6,247,961	7,052,354	9,625,168
Net revenue	3,834.445	4,174,587	6.106,008	6,604,064	5,980,908
Total area in square miles	249,867	249,000	246,579	251,512	251,468
Area under forest W. plans	55,629	57,444	58,588	60,724	60,670

The total acreage for 1918-19 is about 161,000,000 acres.

T. S. W., Jr.

David T. Mason, professor of forestry at the University of California and formerly connected with the timber section of the Bureau of Internal Revenue and the Forest Service, has opened an office as a forest engineer in Portland, Oregon.

SOCIETY AFFAIRS

Concerning Fellows

In view of the nominations which have resulted, in part at least, from the action of a self-appointed committee consisting of Frothingham, Tillotson, Preston, and Wolfe, that committee feels called upon to make a statement of its position.

The Constitution of the Society permits the annual election of ten Senior Members to the grade of Fellow. Election can be secured only by a three-fourths vote of the members voting. Nomination is by either the Executive Council or by petition of twenty-five Senior Members (or Fellows). The Society has hitherto held only one election of Fellows. This was in 1918, when the present six Fellows were elected.

The situation which faced the Society in the fall of 1920 was that one man had been nominated for Fellow by petition, and none by the Executive Council. We believed there were other Senior Members equally deserving of consideration and that it was hardly fair to the electorate to submit only one name for acceptance or rejection. Accordingly, this committee of four made a selection of some fifteen names from the membership roll from which the Executive Council was asked to make additional nominations. This action was taken because we preferred to have the Executive Council make the nominations rather than resort to the alternative plan of securing twenty-five indorsements by petition. As a result of this request, the Executive Council nominated only one man. In other words, it failed to select from our large membership enough candidates to provide a reasonable choice by the Society at large. While conservatism in the election of Fellows should be insured, we do not believe that failure to nominate is a desirable way of accomplishing the object of the Constitution as at present worded. The democratic principle of choice by the whole membership is clearly indicated, though not sufficiently provided for. The failure of the Executive Council during the past few years to act in any systematic manner in regard to the election of Fellows in effect imposes an undue influence upon their selection. Under

such a system nomination might easily become equivalent to election. The committee does not wish to be understood, in this connection, as criticising the Executive Council; the criticism is aimed at the system and the object of this statement is to suggest a remedy.

Under the circumstances, there was apparently no escape from the constitutional alternative of nomination by petition, even though we believed the method was open to serious question. A list of thirty names was, therefore, circulated, suggesting nominations by petition; this list included, it was believed, a majority of those whom the membership would be inclined to consider as eligible for Fellow. As a result of this activity, four additional Senior Members were nominated. Since that time at least nine others have been nominated upon the initiative of other individuals or units of the Society.

With this large list of nominees before us, question now arises as to what we are going to do about it, and how we are going to vote. Probably all agree that the standard set by the six men who have so far been elected is very high and that comparatively few, if any, of the present list of nominees can honestly be said to have attained the same standard of excellence. It is, therefore, a question of either deciding that no more Fellows will be elected or else modifying the standard which was indicated by the first election. We believe that few in the Society are in favor of refusing to elect additional Fellows; it is, however, very difficult to prescribe any standard of excellence for the grade of Fellow which is not subject to a great many interpretations. In the application of any standards adopted, hardly any two men will agree. It is, therefore, hardly worth while to attempt to define more closely the qualifications of Senior Members eligible for election to Fellow.

As we see it, the objects the Society had in establishing the grade of Fellow are twofold: First, to afford a recognition of exceptional merit and high attainment, and second, to make the individual more useful to the profession by giving him the additional prestige inherent in an honorary title such as Fellow. To attain these objects, the number of Fellows must obviously be restricted.

It is our suggestion that the situation be met by amending the Constitution to provide for:

1. An annual vote on Fellows.

2. A maximum of two Senior Members (instead of ten, as at present) to be elected in any one year.

3. An annual nomination by the Executive Council of not less than five names. (It would be preferable not to nominate the same men in any two successive years.) Nominations in this sense would simply be a selection of the best men available, in the judgment of the Executive Council, to be voted on by the membership.

The present provision for supplementary nominations by petition should be retained, although there would probably be little occasion for taking advantage of it. We would not be in favor of changing the provision requiring three-fourths majority for election.

If these changes were made, there would be no danger of increasing rapidly the number of Fellows and thus reducing the honor which it is intended to bestow; the majority of nominations would be made by the Executive Council, which is in a better position to make nominations than is the membership; and annual consideration of this phase of Society activity would be insured.

John F. Preston,
S. L. Wolfe,
C. R. Tillotson,
E. H. Frothingham.

In connection with the preceding statement it may be of interest to the membership generally to know the procedure that I am recommending to the Executive Council to insure the systematic consideration of nominations for Fellowship. According to this plan the Executive Council will review each year the list of Senior Members eligible for Fellowship and will decide which, if any, of these it cares to place in nomination as candidates for the grade. Notice of the decision of the Council will then be sent to each of the Sections and ample time allowed for such additional nominations as the membership generally desires to make through the written endorsement of 25 Senior Members or Fellows. By providing for the annual consideration of the Fellowship question both by the Executive Council and the membership generally this procedure will, I believe, meet the objection that heretofore nominations and elections have gone largely by default.

Another matter of interest, particularly in connection with the foregoing proposal to limit more strictly than at present the number of men who can be elected to Fellowship each year is the informal suggestion that it might be desirable to set a maximum limit to the total number of Fellows and to provide for the election of additional Fellows by the Fellows themselves. This procedure would follow rather

closely that in effect regarding the election of members of the National Academy of Science. Comments both on the specific suggestions contained in these memoranda and on other phases of the Fellowship question will be welcomed by the Executive Council.

S. T. DANA,
Member of Executive Council in Charge of Admissions.

PENNSYLVANIA SECTION IS LAUNCHED

R. Y. Stuart writes as follows regarding the starting of a Section of the Society in Pennsylvania:

Early in the summer of 1920 the formation of a Pennsylvania Section of the Society of American Foresters was discussed by several of the Pennsylvania residents. Up to that time very little interest had been shown in Pennsylvania in Society affairs, due to the scattered location and small number of Society members in the State, and the lack of a suitable opportunity periodically to bring them together.

The petition for the formation of the Section was circulated on July 6 among the 17 members in the State and was signed by all. It is a striking fact that the Society has so few members in a State in which so much is being accomplished in forestry.

There is occasion and need in Pennsylvania for an active Section of the Society. It needs membership for accomplishment, and it is one of the aims of the Section to increase the membership and prestige of the Society in the State. A canvass has been made of the graduates of the State Forest Academy at Mont Alto in order that those qualified for membership might be made interested in the Society. Already 16 names of Mont Alto graduates have been submitted to the Admissions Committee for action.

In Pennsylvania, as in other parts of the country, the majority of foresters practicing their profession are in the public service, and the greater progress as a whole in forestry is accomplished by public than by private organizations. For these reasons it is very desirable that the personnel of the Pennsylvania Department of Forestry be made interested in the Society and become active workers for it. Similarly, the support of members at Pennsylvania State College is needed and has been freely offered. With a greatly increased membership comprised of foresters in State employ, in private work, and

in educational work, there is great promise for accomplishment in Pennsylvania.

The Executive Council approved the formation of the Section on December 7 and the Section's by-laws on February 16, so that it is now formally launched. Its immediate effort is to increase membership. There is also in view, as soon as opportunity permits, a meeting of the Section at which officers may be elected. In the interim I am acting on behalf of the original petitioners for the Section.

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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

ANNOUNCEMENT

THE ANNUAL MEETING OF THE SOCIETY OF AMERICAN FORESTERS

The annual meeting of the Society of American Foresters will be held this year in connection with the meeting of the American Association for the Advancement of Science in Toronto during the last week in December, 1921.

Unlike previous annual meetings of the Society, this Toronto meeting will occupy two days. Opportunity will therefore be given for the presentation of a larger number of papers than has been possible in the past, and particularly for their discussion.

Since the meeting is to be held in Canada, it is hoped that more Canadian foresters will attend than is usual for meetings held south of the international boundary. The members of the Canadian Forest Engineers and the Society of American Foresters, the foresters of the two great English-speaking nations of North America, will thus have an opportunity for becoming better acquainted and exchanging their views on problems common to both countries.

The exact date of the meeting, as well as further arrangements for the meeting, will be announced later. It is hoped that the members of the Society will make every possible effort to attend this meeting and will prepare papers for presentation. The papers should be rather brief, not over 15 minutes for presentation, and be written in a manner that will lend themselves for discussion. In order that the program can be definitely arranged and distributed in time to reach all of our scattered membership, the titles of the papers should be sent at as early a date as possible to any of the members of the Committee on Meetings.

PROF. C. D. HOWE,
University of Toronto, Toronto, Canada.

PAUL D. KELLETER,
Secretary, Society of American Foresters, Atlantic Building, Washington, D. C.

RAPHAEL ZON,
Chairman, Atlantic Building, Washington, D. C.

THE JONSON ABSOLUTE FORM QUOTIENT: HOW IT IS USED IN TIMBER ESTIMATING

By H. R. Wickenden

The method of determining tree volumes and tree taper by means of the Jonson Absolute Form Quotient and Form Point seems to have aroused a good deal of interest in America.

The absolute form quotient, volume and taper tables, and the form point method were discovered and worked up by Prof. Tor Jonson of the Royal Technical School of Forestry of Sweden in 1910.

It was put to actual test in making an enormous strip timber survey of the Province of Varmland in 1912. This estimate covered 7,430 square miles. The results obtained were compared to local statistics and figures already available, and those obtained from local lumber companies, and were found to be exact. It was consequently adopted almost exclusively for timber computations by all lumber companies. The simplicity and flexibility of the method was appreciated by Norwegian and Danish foresters who soon followed the example of their Swedish confreres.[1]

The very fact that the system has been used almost exclusively in Scandinavia for nearly ten years, and that it has practically put old methods out of use, should convince practical men of its usefulness.

Having used it in practice, and seen its extensive application in Sweden during my three years' stay in that country, I am very much surprised to find that, although a very good translation of Jonson's articles was published in America some years ago, American timber estimators still overlook this method of measuring timber, not realizing the advantages and simplifications in lumber estimating and stem analysis work. During the ten years following its discovery, despite severe tests, the form point and form quotient still retain the entire confidence of those who made use of it in their practice.

[1] How far the Jonson method has been tried out in other European countries is uncertain. Where reliable local tables of all descriptions are plentiful, such as, for instance, in Germany, it is not surprising that the interest displayed for new methods of timber estimating is not very pronounced.

BRIEF OUTLINE OF THE THEORY AND METHOD

The volume and taper of trees of any given diameter and height is determined entirely by one single factor, that is, the ratio between two diameters on the tree. The diameters chosen as most convenient for classifying trees according to such ratio are the d. b. h. and a diameter at a point half way between the breast height and the top. This ratio is called the *absolute form quotient;* the expression of this quotient into decimals is called the *form class.* There is, therefore, no numerical difference between "form quotient" and "form class."

The word "absolute" refers to the fact that all trees are treated on the same basis, that is, according to the taper of the trunk *above the breast height.*[2]

Two sets of tables are used, one for volume, the other for taper. Each is arranged according to diameter, form class, and height of all trees.

That is, knowing the diameter, form class, and height of a tree of any species, you can obtain from the tables its volume or taper series.

Moreover, it does away with extensive stem analysis, being as accurate in new regions as in those where conditions are already known.

This eliminates the necessity of making local volume tables. Once the tree tallies are made and the factors affecting volume, including form class, are secured, the volume tables will give you the volume, and the taper tables, the number of logs of any specified size for the locality in question.

Determination of the Form Quotient

The form quotient of any type does not vary much even for large regions. There are at least two methods of obtaining the form quotient. (1) *Direct measurements on trees.* The middle diameter is measured on felled trees, or by observations on standing trees from the ground, by means of any suitable instrument.[3] One could even use tree climbers to obtain the middle diameter. By choosing fairly

[2] This is contrary to the procedure followed by Schiffel, Mass, and others whereby the d. b. h. (whose relative location varies according to the height of the trees) was compared to the diameter half way up the total height of the tree. Thus, for a tree 30 feet high, the d. b. h. lies at 15 per cent of the height, but for a tree 100 feet high, it lies only at 4.5 per cent of the height.

[3] Several such instruments have been devised but do not seem to have been used extensively in any country.

normal trees it will not require many trees to determine the form quotient which in any stand will be found to vary within probably less than one to four per cent. (2) The simplest, even if not the most accurate way of determining the form quotient is obtained indirectly from the "*form point method.*" The form point is the center of gravity of the crown as seen from the side. That is, the center of gravity of a vertical section through the center of the crown of the tree. This point is located and expressed in figures by giving its relative location in per cent of the total height of the tree. It is determined thus: If one considers the crown of a normal tree one can readily determine approximately where the center of gravity of the crown seems to be. For instance, if the crown were triangular this point would lie about one-third of the way up the crown; if the crown were square it would be in the middle of the crown. Taking a fractional hypsometer or any rule graduated in ten parts, one holds it vertically, extending the arm in such a way as to line in the top of the tree under observations on the ten mark and simultaneously line in the stump on the zero mark. Glancing quickly at the spot, where one had decided the form point was located, one notices where it seems to line in on the scale. As the scale is in ten parts, the reading at this point indicates the per cent of the tree's height at which the form point is located. The form point is now used as argument in a set of Jonson's tables giving the relation between form point and form quotient.

Each per cent is considered as a unit of form point relative height. Generally speaking, the form point is situated at 50 to 75 per cent of the height for ordinary trees. Two form point units' variation causes less than one unit variation in form class, thus it can be seen that the volume figures are not greatly affected and that a good average can be secured with a relatively small number of readings. In any stand the average run of form points found should be within ten units, that is, for instance, between 0.60 and 0.70. (Spruce and fir will generally have a form class around 0.65, pine in dense stands may have a form class of over 0.70.)

One should not apply the form point to individual trees; this needs no comment, for all figures and tables used in forestry work are made up from, or deal with, averages. The form point is not an exception to this rule. Used with discretion it will give results which will always lie within the accuracy required for practical purposes. For

scientific research it will be found a great help when direct measurements for precise form determination cannot be made.

The form point method is now always used in Scandinavia. My work with it here in America gives me reason to believe that the method is universal, at any rate as regards the temperate zone.

APPLICATION OF THE ABSOLUTE FORM QUOTIENT METHOD ON A SURVEY

I will assume that it is being applied to my present cruising method, realizing that there are many modifications in cruising due to local conditions and personal preference.

Timber Estimate of an Individual Stand

The trees are tallied in say two-inch diameter size classes, also subdivided into sound and unsound, or even dominant and subdominant trees if desired. Simultaneously or subsequent to the tallying, comes the taking of readings for securing special information on "sample trees." The larger the stand the smaller the percentage of trees necessary to obtain reliable average figures and curves. Even for small stands of, say, 15 to 20 acres in dense forests, sample tree readings taken on every hundredth tree would give fair results. Using a suitable blank form, or even plotting the points directly on a special sheet, one enters for each sample tree, the height (measured say with a Christens or fractional hypsometer) the relative location of the form point, the exact diameter, and the bark thickness at breast height. If age and growth were required the boring would be done simultaneously. The taking of these readings should only take two or three minutes per tree.

It is very important to remember that in all timber estimating, in fact, in the applying of figures to any of nature's work, we must always go by *average results.* The individual variation and exceptions may be considerable but should not be allowed to have but very limited influence on averages. Consequently, many trees taken with ordinary care are much more likely to give exact results than few trees taken with minute precision.

While the Jonson method will often work for individual trees, its application is intended for homogenous groups of trees and gives average results. The single tree readings should be plotted on squared paper, using d.b.h. as abcissa for all curves, to determine: (1) The

height curve. (2) The bark thickness curve. (3) The form point curve.

One can also simply take an average form point, from readings on trees of average size or even average up all form points and supply the average to all sizes. This procedure is really quite accurate in total results.

Application of the Tables

Once these curves, etc., are ready we start to use Jonson's tables. Looking up in the tables, one finds the form classes corresponding to any form points. It is customary to show a form class curve with the form point curve on the same ordinate and abscissa. The form class is more horizontal than the form point curve. Taking from the curves the d.b.h. *without bark*, the heights and the form classes, the volume is then obtained from the tables.

The form class is expressed in decimals and usually lies between 0.55 and 0.75. One generally refers to the unit as being 0.01. This unit only causes a variation of approximately 1.5 per cent in volume; it is therefore, not necessary, for ordinary purposes, to make minute interpolations for form class but rather try to take it in the nearest round figures. One can either look up the volume of the average tree of each diameter class, or, only looking up for diameters in even figures, draw up a volume curve. I prefer to put all the curves one above the other having the same diameter scale as abscissa right through, so that by following one vertical line, one gets the different factors from each curve in turn.

Summarizing, the process consists in the following operations:

1.—Tallying trees in diameter size classes.

2.—Making observations on sample trees for height, bark thickness, form point, etc.

3.—Finding the averages of the different factors by means of curves or otherwise.

4.—Looking up volume in Jonson's tables using height, diameter, and form class as argument; or, if for example a log specification is required, getting the diameters at any point on the stems from the taper tables.

The Use of Form Quotient Taper Tables

One of the most common objects in using such tables is for making log estimates. As a concrete example, supposing that in a certain

region, logs were cut preferably to certain fixed diameters and lengths. The trees having been tallied in certain fixed diameters size classes, the average tree of each class is then analytically cut up into logs of the desired size and the result multiplied by the number of trees in the respective classes. It is to be noted that the smaller the range of each class the more accurate the results will be.

The analytical procedure is therefore a question of applying taper tables to certain trees of given height, diameter and form class. In the Jonson Absolute Form Quotient tables, the taper in per cent of d.b.h. is given for trees of different height and form classes. Thus, in making up the analytical log output, one picks out the proper height and form class and works up each tree finding at what height the different log diameters are to be found.

Certain handy devices such as the local tree taper chart local height and volume tables are commonly used. I also applied the ordinary engineering graphical charts while in Sweden about five years ago and have found they very handy. There are many ways of putting up hand book data just through using the form quotient as a key. Ihope to give out some of the above in a future article.

Timber Estimate of a Whole Region

There is no material difference in the use of form quotient volume or taper tables for a cruise applying to a whole region, with the procedure outlined for a single stand.

Generally speaking the following methods present themselves:

1.—One can treat each stand individually.

2.—When the cruising only covers a small area, say, a few thousand acres, or summarized figures only, are desired, one can deal with the whole cruise in lump figures.

3.—One can arrange the stands in groups or categories and deal with each category as one did with the stand.

There is nothing special to remark about the first and second procedure. The one gives very exact detailed results but entails considerable clerical work, the other does not necessarily give accuracy for any individual stand, but the total results should be very close. The sample trees for this last mentioned summarized procedure should be gathered in some objective manner over the whole region, for instance, five or ten trees every quarter mile, one or more trees for every so many tallied, etc. The idea being to secure enough material to give definite curves.

To my mind however, the third system mentioned above is the best compromise for an ordinary extensive cruise. That is, to deal with the stands in categories or groups. This is really the case where cetain fixed types are adopted and the stands assigned to the type that fits them most nearly, or else where fixed types are not used but each stand is described individually. I prefer to use this latter system since the grouping comes in only as far as the volume computation and other calculations are concerned, but each stand is characterized on its own merit.

One assumes that there are two, three or even four variations or classes occurring for any well-defined type of forest. The stands are each assigned to any one of these classes by the estimator in the field, according to whether the trees are relatively tall, medium, short, or scrubby. This same idea is borne in mind in the observations on sample trees, these being ascribed to their proper class.

To make this matter more clear, let us consider a specific case. Supposing a section was to be cruised where a certain kind of mixed hardwood or coniferous forest was abundant. This forest type might be found existing in very fertile locations where the trees grew relatively tall. Again it might be found on side hills where growing conditions were fair and the trees were of average height. Lastly, the mixed type might exist on mountain tops where the exposure and other climatic conditions caused the trees to be somewhat short or stunted. One could here, conveniently define this mixed wood forest in classes 1, 2, and 3; the finest stands being put in class 1, the average stands in class 2, and the exposed stands in class 3. These classes might be called "volume classes."

Use of Height in Classifying for Volume

Height, which is a certain criterion of volume, can conveniently be used in ascribing each stand to its class. It is, in fact, quite common to look over a region before a large estimate is undertaken and to draw up a tentative height curve for each such class. The final results are worked up to give their own modified height curve for each class, as well as their form class curves, etc. Then, again applying these results to Jonson's Form Quotient tables, we work out the volumes, the number of logs, etc., as before. Of course there are certain personal errors creeping into this procedure but their influence is limited to the placing of a stand in one class or another; the difference in volume between any two classes need not be very great. Barring

such possible misplacements, fairly accurate information is available for individual stands.

ACCURACY OF THE ABSOLUTE FORM QUOTIENT VOLUME TABLES, TAPER TABLES, AND FORM POINT DETERMINATION OF FORM QUOTIENT

The question naturally comes up in many minds, "Does this system apply to American conditions as well as it does to European conditions?"

Generally speaking, the system consists in classifying trees according to the shape of their stem, and, so far as the form point is concerned, this shape seems designed to resist lateral wind stress.

Speaking of the temperate zone, there is no apparent reason why trees in any one part of the world should differ in their general form from those in any other part, that is, that there should be different sets of "stem forms," especially when one considers that trees of any one species have the same general appearance in any country. Personally, I have been impressed with the fact that, barring marked local features, forests are remarkably similar wherever I have seen them. Trees have similar shapes and appearance everywhere; they are subject to the same general natural phenomena, some of which favor their development, some of which are detrimental; the forces of nature such as wind, gravity, etc., are the same. When visible characteristics of trees and nature's laws are the same, would there be more reason for indirectly visible features like stem form to be variable? It is not likely.

This reasoning gave me hopes that the Jonson system could in a broad way, be directly applied in America. Comparison with official publications on the form of different species showed a surprisingly close agreement. My actual use of the Jonson system in northeastern forests on extensive cruises I have carried on and the testing of form point observations with stem analysis work have also given very exact results.

Comparison of the Jonson Form Quotient Tables with American Data

Taking data given by Raphael Zon in Bulletin No. 55 on Balsam Fir, we can pick out two examples at random:

Balsam on hardwood slope and flat:

D.b.h. 9 inches, height 50 feet, total volume 0.119 cords.

One cord for such a tree contains 95.925 cubic feet.

Total volume is therefore, 11.36 cubic feet.

Applying the taper figures given to the Jonson formula,[4] one finds that the tree's form class is 0.690. The Jonson tables give for a tree 9 inches d.b.h., height 50 feet, and form class 0.690, a volume of 11.45 cubic feet as compared to the 11.36 given by Zon.

Balsam in Maine. (Same Bulletin):

D.b.h. 13 inches, height 80 feet, total volume is 0.368 cords per tree. One cord for such a tree contains 98 cubic feet. Total volume is, therefore, 36.10 cubic feet.

Doing as before, one finds such a tree's form class to be 0.663. Jonson's tables give for a tree 13 inches d.b.h., height 80 feet, and form class 0.663, a volume of 35.95 feet as compared to the 36.10 cubic feet given by Zon.

Taking data given by William Dent Sterret in Bulletin No. 820 on Jack Pine, a jack pine of given d.b.h. and height are shown to have certain taper series. Obtaining their form classes as before (or even graphically, especially if root swelling extends up to breast height), one finds the comparison between the Sterret and the Jonson series in Table 1.

TABLE 1—*Diameter in Inches at Different Heights Above the Ground.*

Height above ground (feet).....	4.5	4.15	17.3	25.43	33.6	41.75	49.9	58.05	66.2
Sterrett: (36 trees), d.b.h. on bark 7", h. 50'.............	6.4–	6.0–	5.3–	4.4–	3.3–	1.8–	......	......	......
Jonson: Form Class 648, h. 50'...	6.40	6.06	5.30	4.40	3.30	1.91	......	......	......
Sterrett: (6 trees), d.b.h. on bark 12", h. 80'.............	11.0–	10.5–	9.9–	9.2–	8.6–	7.8–	6.8–	5.6–	3.8–
Jonson: Form Class 0.706, h. 80'..	11.00	10.66	9.80	9.21	8.62	7.82	6.82	5.61	3.81

[4] The formula used by Jonson was the Höjer equation: $\frac{d}{D} = C \log \frac{c + h}{c}$ where "d" is the diameter at any point above the d.b.h., "D" = d.b.h. C and c = constants and $h = \frac{\text{total height} - \text{height of d}}{\text{total height} - \text{breast height}}$

Root swelling must be graphically eliminated, otherwise too high a form class will result.

The agreement between the actual measurements as given in the bulletins and those obtained by applying the Jonson table is remarkable.

In my own field observations, I obtained the following general results in applying the form point to balsam, spruce, and jack pine in Quebec Province.

Determination of volume of white spruce from stem analysis in the St. Maurice Region, Quebec, compared to estimates made on the trees before they were felled (32 trees):

Average volume per tree, 22.75.

Average form class as determined by direct measurements, 0.662.

Average form class as determined by form point observations on standing tree, 0.659.

Average volume per tree obtained from Jonson tables by using this latter form class, 22.60.

The estimated results are thus 0.66 per cent too low.

A standing 10-per cent estimate made on a certain area intended for pulpwood cutting gave 5,282,327 feet board measure and 262,341 logs, according to the Jonson taper tables. The actual scaling after the cut gave 5,532,842 feet board measure and 259,631 logs.

The estimated results had, therefore, an error of about 1 per cent too high in the number of logs and 4.5 per cent too low in the volume.

Such a result could, in my estimation, be considered exceptionally accurate. However, it indicates a possibility. The Jonson taper tables usually give close results. In such work, of course, the classifying of trees in the tallying has also a very direct bearing on the results. One should always be careful to take into consideration any root deformation which extends as high as the breast height. The Jonson forms follow a straight course downward past breast height. Graphical analysis will show up any curving due to root swelling and the d.b.h. could be reduced to the true proportion. A good rule to follow is to take the d.b.h. a little higher when the root swelling is suspected.

As regards the form point determination the tendency is to take it somewhat low. This would cause volume results to be if anything, too low. However, this is a safe error in timber estimating.

Apparently the Jonson system holds true when tried in American forests. It is to be hoped that foresters will make use of it. One may later find deviations from the rule but in my opinion these will never be large enough to prevent its unrestricted application for commercial practice.

There is much interest displayed by certain foresters for the Jonson Absolute Form Quotient system, in fact, a set of tables translated and converted into English and English units is much desired. The work of compiling and printing them is started. With the interest and collaboration of Professor Jonson and others, it is to be hoped that these tables will soon be completed, to facilitate the work of all those who begin to apply the system in timber estimating and computations.

FUR CULTURE ON THE NATIONAL FORESTS

By Smith Riley

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The Federal Government has been entrusted with the responsibility of protecting and bringing to their highest use 156 million acres of public forest land in this Nation. The protection, culture, and use of the trees, of course, is the first purpose. However, when full consideration is given to the variety of the types embraced in these reservations, it will readily be seen that the possibility of cultural use covers an enormous field. Obviously, in the establishment of reservations to cover certain types of land, full recognition must be given to the place these lands occupy in national use and no opportunity should be lost to have them do their part in economic production.

There are many uses to which lands producing trees can be put without interfering with the principal purpose. Such production may be considered as by-products from the forest lands and while considered in this capicity it may take its place as no small feature of the lands production as a whole.

It has been said that the demand for fur has existed since primitive man sought skins to shield his body from the cold. This demand is fundamental and will endure while man inhabits the earth and furs are to be had. Its strength can be judged by the volume of trade it supports. In 1913 the dressed and manufactured furs imported into the United States were valued at more than $15,000,000. North America furs annually marketed in the United States and England have an approximate value of $60,000,000. These figures show the commercial importance of fur, and in addition to this the fur trade furnishes a livelihood for many thousands of workers in the factories and stores of the country.

The fur resources of the United States have been destructively used throughout the whole life of the Nation. In the history of the fur trade there is not one instance of constructive action looking to the building up of this valuable resource. In Chittenden's accounts of the far western trade he repeatedly refers to the detrimental results in the destructive methods employed in the development of the trade.

In the early days the Government refused to limit the competition which did more than anything else to decrease fur production. Of later years as some States passed laws controlling the taking of fur-bearing animals nothing has been done to define fur production areas or to stabilize production by ascertaining that amount of fur of the different kinds which a given region should produce. That such action was entirely possible is shown in the experience of Canada, where the strife of rival companies bid fair to destroy a vast resource when steps were taken to limit the activities of one company to a given region. This act alone, aside from any laws controlling the catch, did much to stabilize the industry through permanent interest in production from a given region over a long period of time. The trappers dealing with the companies were encouraged to leave animals for breeding. Later, I believe, laws were enacted to enforce this very point.

In many of the States where there are National Forests trapping beavers is prohibited, though provision is made to take such animals as destroy property. Little interest is taken in the protection of fur-bearing animals, with the result that applications to take beavers on the grounds of active damage are not investigated, resulting in much taking of beavers without compliance with the laws for protection.

Where there are closed seasons or where trapping fur can be carried on only under permit, no attempt has been made to ascertain the productive capacity of the region, with the result that, even with the closed seasons upon some of the more important animals, in many of the States, the fur resources of the United States have steadily diminished during the last half century, far beyond any justification. Present conditions point beyond a doubt to further shrinkage. The decrease has been in the quantity of the better pelts and not in the total value of the catch.

Beavers, otters, martens, and fishers have disappeared from much of their former range, and even minks, raccoons, and skunks have become scarce in some localities. The result is that many kinds of thinner furs have come into the market with an almost prohibitive price upon beaver fur. The following statement is taken from Chittenden's History of the Fur Trade in the Far West:

"The great importance of the beavers in the life of the hunter and trapper arose almost entirely from the commercial value of its fur, which is one of the finest that nature produces. At this early period in particular it was in great demand. An average price was four

dollars per pound and as the little animal carried from one to two pounds in its body the premium for its destruction was from four to ten dollars according to the size and the prevailing price of furs. As the streams of the West—of the whole country for that matter—originally swarmed with these animals in numbers that rivaled the illimitable buffalo herds of the plains, it will be readily understood what a mine of wealth here lay open to the industry of the trader and the trapper.

"Every stream of the West was as rich as if sands of gold covered its bottom—a richness moreover, which if gathered with judgment and not to the degree of extermination, would renew itself by natural increase.

"The beaver also supplied another article of commerce, a secretion from two small glands of the body. This was always known in the commerce of the mountains as castorum. In the arts it is more commonly called castor. In the mountains its value was about three dollars per pound. The castorum was used as the beaver's bait, and thus the little animal itself supplied the means of alluring its race to destruction. The extensive use of the beaver fur in the early years of the century caused an increase in exportation from America to Europe, reaching as high as 200,000 skins annually. This great draught on the supply led to the rapid extermination of the beaver."

In Mr. Chittenden's book, The Yellowstone, is the following statement:

"But a business carried on with such relentless vigor naturally soon taxed the resources of nature beyond its capacity of reproduction. In regions under the control of a single organization, as in the vast domains of the Hudson Bay Company, great care was taken to preserve the fur-bearing animals from extinction. In the United States territory the excess of competition made any such provision impossible."

There is not an instance in any section of the country of a departure from the original destructive policy. It is true, protective laws have been passed by many of the States but under the existence of the laws there has been no effort devoted to a systematic study of the problem looking to a plan for stable production. The growing sentiment for wild-life preservation coupled with the realization of the place beavers fill as water conservers in the irrigation regions has done much to direct attention toward better methods of protection. This has been particularly noticeable in those States where there has been a closed season and the animals have increased to such an extent that a cry has been raised of damage to crops. Those who wish to prey upon the beaver seek to gain their ends by noising their destructive tendencies.

There is no question about the damage done by beaver to both ditches and crops, so their development in an agricultural district requires constant attention to prevent damage. In face of this fact there are many ranchmen or agriculturists who accept the trouble entailed by the presence of the animals for the satisfaction of having them in existence upon their property. A good example of this is found in Colorado which has had a closed season for many years. Even with provision in the law for taking such animals as cause damage and without check by the State authorities and the wholesale disregard of the law, the beavers have increased to such an extent that repeated efforts are being made to change the law so that the animals can be taken without restriction. One interesting feature is the extent to which the animals have increased in face of much abuse and with only the slight protection afforded by the ineffective enforcement of the law. This shows their persistence and what might be done with the animals where suitable culture areas are available. There is much stream area in the range of ditch-heads and cultivated lands where beavers can exist to advantage with little property loss. I do not believe there exists any general sentiment among those interested in the lands for the complete elimination of the animals from this type. There are those who deplore the property loss and would destroy the beavers completely, feeling that property should be first and seeing no value in the animals. There are those who covet the products of the beavers and agitate the damage feature to gain the assistance of those who would destroy the animals to protect property. Considering the failure of two legislatures to open the season, I feel that those in favor of protection are in the majority.

If there were only the stream reaches in the range of ditches and cultivation, the general conditions would offer many features encouraging to a study for development of a workable plan for production. When we add to this the many miles of suitable water well supplied with food and entirely removed from conflicting interests, the possibilities for a substantial return from the lands and the development of an industry which will not interfere with the land production in other ways appear very feasible. The National Forests are for the most part mountainous lands which will remain in a wild state and they therefore offer excellent culture areas for fur animals. Another point which should be given full consideration is that the forest lands con-

trolling the upper waters of all the principal streams in the mountain country are the natural culture grounds for these creatures. Besides, the nature of the administrative units creates an obligation for the complete production from the lands.

The beaver conditions in the Cochetopa National Forest in Colorado is an excellent example of what can be done in the average mountain region suitable for beaver culture. It is estimated that this Forest which covers some 900,000 acres contains 12,000 animals distributed over about half the available water area suitable for production. As the animals were causing damage to ranch property in one locality near the Forest boundary, steps were taken to draw up a plan for co-operative trapping with the State game department. The plan had in mind the elimination of the beaver where they were actually committing damage to private property, but at the same time maintaining them in the streams of the Forest as a continuous source of revenue; in other words, the placing of the beaver in the light of an asset rather than a detriment. It provided for the extermination of the beaver where they were committing actual damage; allowing them to increase unmolested in streams of the Forest not fully stocked; and finally the transplanting of the beaver to streams where they do not at present exist, and where food and other conditions are thought favorable for their propagation.

The trapping was done on Cochetopa Creek. This stream, about 15 miles in length within the Forest boundary, has an almost continuous series of dams from the boundary to above timber line. Below the Forest there are several ranches where the beaver are causing damage. The damage consisted in flooding hay meadows and obstructing irrigation ditches, and was investigated by the local forest officers before submitting a recommendation for the trapping. The stream, therefore, afforded a combination of both conditions under which trapping was justified; that is, a full stocked stream and also a locality where the ranchers were suffering actual damage.

Upon the recommendation of the Forest Service, a trapper was sent by the State with instructions to work under the direction of the forest supervisor. When he arrived the latter part of April, the work was outlined to him as follows: (1) To try to completely exterminate the beaver on the ranches below the Forest where the owners desired this to be done, and for a distance of half a mile within the Forest to prevent interference with a big irrigation ditch; (2) to reduce the number

for a distance of about five miles within the Forest, with the idea that it would give the remainder room to increase without working down upon the ranches and causing an immediate recurrence of damage; (3) to leave those on the upper courses of the stream unmolested with the idea that, if the trapping proved too heavy or caused the beaver to migrate to another locality, they would work down the stream as they increased, thus restocking the portion trapped.

There was no actual evidence that heavy trapping might cause the animals to migrate, but the work being new and in a somewhat experimental stage, it was thought best to leave them undisturbed on a portion of the stream. In fact, the result of the past spring's work indicate the contrary, as will be discussed later on.

Ice prevented operations when the trapper arrived, so he put in his camp and looked over the ground in preparation for the work. He started trapping about the first of May and trapped until the first of June. During this time he caught 132 beaver with No. 4 Newhouse traps, using twenty.

In regard to costs it is regretted that actual figures can not be given as the local forest officers did not know definitely whether the trapper was paid a salary or was allowed a part of the hides. However, regardless of how the State handled the matter the net revenue must have been considerable, in view of the size of the undertaking. The local forest office was informed that some of the hides brought as high as $33, and that the total gross returns were $3,000. Assuming, however, that the State was able to hire the trapper for $100 per month, and that the expense of the trip was about $100 in addition, which seems reasonable, the cost of trapping the beaver would be about $1.50 each.

The trapping was not sufficiently thorough, on and in the immediate vicinity of the ranches, in that the beaver were not completely exterminated. Some have been left, and they may again become a source of damage. However, if trapping can be done at frequent intervals on the stream, this will likely be obviated. In other words, with some attention to quash destructive tendencies beaver may continue to occupy this locality.

Along the five-mile stretch within the Forest, there is a noticeable reduction in the number of beaver, but this is not as marked as might be expected. Observations made the following fall indicate that with

three or four exceptions all dams within the stretch are still inhabited. This would indicate that the trapping within the Forest has been sufficiently conservative; and if desired, the stream could be safely trapped again next spring without reducing the stock below normal; that is to say, probably not more than the normal annual increase for the stream has been trapped. It is planned to make further observations of the results next summer, and to defer recommendations for further trapping on this stream for the present. It is planned, if the State can be induced to send one, or preferably two trappers, next spring to undertake similar work on two other creeks, both of which are heavily stocked and along which some damage to ranches is occurring.

It might be added further that the estimate of the number of beaver in Cochetopa Creek and tributaries was 1,200 head, and that the apparently small reduction in numbers following last spring's trapping would indicate that this estimate is conservative. It is more likely under rather than over the actual number. It might also be added, that twenty beavers were trapped from this same locality on the stream under permits to local ranchers, the fall previous to the State trapper undertaking the work, making the total number trapped from the stream during the past year 152.

The State trapper failed to take any of the beavers alive for planting, so a permit was issued by the State to the forest officers to do the live trapping.

It was planned to use the woven-wire-corral method of trapping the beavers, but owing to the lateness of the season and probable length of time it would take to get them in this way, the ordinary steel trap was resorted to and they were visited at short intervals so that any animals caught would not injure themselves. It is realized that this was a very crude way to do the work, and might result in considerable injury to the specimens taken. Fortunately this was not the case with the two trapped, and both of them were removed from the traps without suffering severe injury or being crippled.

An ordinary box was made 2 feet by 2 feet by 3 feet, with sliding door for transporting the animals. One-quarter inch cracks were left between the boards in making the box to allow for air. It was lined with chicken wire to prevent them from gnawing, and both were placed in the same box. They made no attempt to gnaw out and caused very little disturbance while in the box, being comparatively docile after being once captured. One was inclined to fight while being removed

from the trap, until released from it. The first one was placed in the box directly from the trap; the second one was carried to the box in an old gunny sack. It scratched around some, but did not attempt to gnaw its way out. The two captured were two-year-olds. In trapping the pair an extra male was caught. It was transferred to Carnero Creek with the idea that we might later be able to get a mate for it, but were unable to do so.

The beavers were transported by automobile from the place trapped on Cochetopa Creek to the upper Saguache Ranger Station, and thence by wagon about 10 miles to where they were released in Houselog Creek. The first beaver captured was in the box three days and two nights before being released. He apparently suffered no injury from the confinement or from the long period out of the water. Both were in good condition when released in Houselog Creek.

The beavers were released just above the upper ranch on Houselog Creek. The sentiment of the local ranchers and homesteaders along the creek is favorable to the propagation of beaver, they feeling that if the stream becomes stocked, they will benefit through the holding back of the water, making more for irrigation in the late summer.

It is, of course, too soon to predict the result of the work, but it is thought that it will be successful. There is an abundance of aspen along the stream for feed. Two or three weeks following the release, little was seen of them, but aspen cuttings were observed at different places along the creek. They apparently wandered around considerably before settling down; but the last observations of Ranger Gallegos showed that they had established themselves just above the fence of the upper ranch on the creek, and had built a den in the bank. They have not built a dam, but it is doubtful if this is essential, since some of the beavers in this locality do not construct dams. This will be discussed further on.

When the beavers were released from the crate and turned into the creek, they were apparently somewhat bewildered. One started up the creek and the other down. In order to keep them together Ranger Gallegos headed off the one going down the creek and started hazing it back toward the other one. The empty crate was lying on the bank, the beaver in passing it evidently regarded it as a place of protection and ran back into it. Ranger Gallegos then closed the sliding door, and carried it up stream to the other one and released it. In the meantime the other one had worked up stream, and finding a hole in the

bank, stuck his head into it and remained there. He was prodded up with a stick, but would not move, seemingly considering himself out of sight and protected.

The plan of management provides for the restocking of all streams of sufficient size in which beavers do not at present exist, and along which there is sufficient aspen or other food for them. There are only five such streams on the Forest. It is hoped to continue the with the cooperation of the State if it can be secured. If not, and authority is granted us, it is hoped to carry on a small amount of this work each year, incidental to regular duties, until it is completed, or until at least a pair is placed in each stream. Judging from the results of three transplanted in Itasca Park, Minnesota, in 1900, and the rate at which they are thought to be increasing here, it is not thought that a large nucleus will be necessary; but if sufficient cooperation is extended by the State in the way of furnishing a professional trapper to assist, it is thought that four to six per stream would be better. This would serve to bring up production in the shortest period of time and serve to show what improvement in stream conditions can be expected from the ranchmen's point of view. A clear demonstration of the stabilizing effect upon the stream flow of beaver activities will be of value in fixing their place.

It is planned as an experiment to try to catch them with a woven-wire crate or net placed with the opening over the entrance to the house or to the entrance of the den in case of bank beaver, first closing up the other one of the two entrances. Then, by poking them up in their den, it is proposed to force them out and into the net. This should work during the daytime, since from what information there is available they remain in the dens or houses during the day, and are not easily disturbed. This has been talked over with one or two of the local trappers who think it feasible. If it fails, the wire-corral method will be used.

Also, in undertaking any future work, it is planned to catch the beaver earlier in the season, preferably about the first of August, since high water is then over, making it easier to trap them, and allowing the planted specimens more time to become located, build a house, and store food before winter sets in.

The work was done on contributed time. The cost in contributed time is high owing to the work being new and in a more or less experimental stage. An attempt was first made to trap the beaver from

Saguache Creek because of the shorter haul to the stream in which they were to be planted. It was not a success here, and later the camp was moved over to Cochetopa Creek. Three days were spent by two men in the first attempt. Also three days in the successful attempt including the move over and return:

Cost in contributed time in trapping	$25.96	
Travel expense and auto mileage	11.60	
Cost of crate materials, lumber, etc.	3.00	
		$40.56
Transportation by auto (mileage)	$3.50	
Transportation by wagon (use of team and wagon donated by Ranger Gallegos), his contributed time	6.78	
		10.28
Total		$50.84

The estimate made of the beavers in 1918 showed 12,000 in the streams within the vicinity of the Forest. While this may have been a little high at the time, it is believed to be conservative at the present time. Anything approaching an accurate census, however, has not yet been made. It is going to require rather close observation and considerable time. On streams, like Saguache Creek, which are subject to flooding and washing out of dams, not nearly all of the beavers construct dams. They often simply burrow into the bank and make dens without them. This fall numerous runways and cuttings of willows were observed along the creek, and dens, without any attempt to build dams. The observations of local trappers and also of the State trapper corresponds to the information given by the Biological Survey that they average about four kits to the litter. From information obtained from J. D. Figgins, of the Colorado Museum of Natural History, they have a litter each year, and the young ones remain with the old until they are two years old, or until the third litter is born. This would indicate that there are two litters in most dams. There is one point, however, which has not been cleared up. That is, whether the secondary dams are also regularly inhabited. Some claim that the two-year-olds occupy them when pushed out by the parents, but there is a difference of opinion as to this. With the gathering of a little more information as to their habits, it is hoped to make a start toward a more accurate census, but it is going to require time and close observation.

Likewise, there is very little information about natural losses and rate of increase. Estimates of the numbers in Long Branch Creek showed 50 beavers in 1908 and 3,000 in 1918, indicating an average

yearly increase for the period of about 50 per cent. This, however, is based only on estimates. In order to be conservative, an annual increase of 25 per cent has been assumed until such time as more accurate information can be obtained. It is evident at any rate that they increase rapidly, judging by the new dams constructed each year.

Picture the conditions just described. The stream flowing from the mountain slopes with every drop of water taken for irrigating the cultivable lands in the plains. The beavers, which were once as plentiful as the buffalo and which were swept away through destructive methods of use, have increased along some of the streams so as to become noticeable. There is a growing realization of their value, not only for the fine quality of their fur, but for their service in building dams, to stabilize the flow of irrigation water through soil saturation. This point is not entirely clear but its outer lines have a growing permanency tending to stay the hand of destruction, and increase the interest taken in the presence of the animals. It has been known that beavers cause damage by interfering with the flow of irrigation water. This knowledge has been made the excuse in many cases for their molestation or complete destruction. But, as shown in the Cochetopa work, there is a growing realization of the possibility of control so the benefits are realized and the destructive tenancies of the animals kept at the minimum.

The lands are in the National Forests with every indication of being suitable and so extensive in area as to offer unlimited possibilities. The little that is known of the beavers and their very persistence makes them particularly applicable for cultivation on this type of land.

Picture the activities of those two rangers in the Cochetopa work. The very nature of the interest stimulated by the character of the administration based upon the proprietorship of the lands, is more potent than that which can be brought to bear on the subject from any other source. The State officer tackles the question in a way calculated to arouse impatience among those interested. The trapper employed by the State showed no activity in that phase of the project relating to taking the animals for planting. He was interested in taking the product of the beavers. Whereas your forest officers want to work upon the proposition of establishing the animals on the streams suited to their permanent occupancy. The Cochetopa work brought out how important is a knowledge of the animal's habits in attempting to successfully control them.

Beavers have been attractive, aside from their values, to man the world over. A curious tradition prevails among the Flathead Indians concerning beavers. These animals so celebrated for their sagacity, they believe, are a fallen race of Indians who have been condemned by the Great Spirit on account of their wickedness, to their present form of brute creation. At some future period, they believe, these fallen creatures will be restored to their proper state. No phase of the forest work in the United States offers more stimulating features than that of defining the limits of wild life culture in relation to forestry. Visualize the mind activities of those two rangers in planning and executing this planting project. The preparation for the trip; the three days of unsuccessful operations on one creek, the move and the successful issue. The oft-occurring thought to these rangers of how the beaver family is faring through the seasons. The keen appreciation of trips into the locality to observe the operations of the family. Could there be any more pleasurable duty for a live, active man whose work keeps him in the open

I have traveled for days on end through the Forests of Wyoming over lands of first quality for fur animal production. A trapper at Valley Wyoming wrote me not long ago that he had out 200 miles of trap lines and he was not doing so well because the marten were scared. That while there was lots of feed, such as rabbits and squirrels, in the region where he was trapping, the marten were not there and he guessed they had just been trapped out. In fact, he believed the only hope for the marten is a closed season.

The Forest Service has an agreement with the Wyoming State Game Department which provides that all applications for trapping permits will be submitted to the forest supervisor concerned for consideration and recommendation before action is taken. Now it is true that the present State game warden, dealing in generalities, has expressed himself in favor of the destruction of all fur animals because he claims they prey upon game birds. Upon the other hand, the Wyoming law is so worded that the issuance of trapping permits is discretionary and there are some eight forest supervisors supported by observant rangers conversant with all animal range types in the State. Surely an active force of such size in a fertile field should be able to bring forth sufficient evidence to convince one man of the unsoundness of his position. Game birds were plentiful in the Shoshone National Forest when I

first knew it 15 years ago at a time when fur animals were much more numerous than they are now. Food and seasonable weather have far more to do with the prevalence of game birds, say the grouse family, than the presence of fur animals. Continued cold wet weather, when the chicks are just hatched, plays havoc with game birds just as a scarcity of food in any section may cause the birds to migrate. The weasel, I have no doubt, is most destructive to all bird life, however he is not much sought by the average fur trapper.

My idea would be the preparation of maps of the Forests for the State game warden designating certain watersheds where trapping of stated animals should be prohibited for a given period of years. There must be sound reasons for this recommendation which are set forth in detail. Such elimination of the taking of fur animals to let them reach a normal production should not in any way interfere with trapping wolves, coyotes, and cats.

Certainly the subject of fur production offers an excellent field for action with obligations for initiative upon the proprietors of the lands best suited to such purposes.

THE CALCULATION OF THE MEAN FIBER-LENGTH OF A TREE

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In finding the mean length of the fibers of a tree it has been found convenient to cut discs or cross-sections at certain distances along the felled trunk, thus obtaining sample layers which were at definite heights from the ground in the standing tree.

The volume of wood to be represented by each disc can be estimated fairly accurately. It might be assumed, for instance, that the disc represented half the length of the bolt above it and half that of the bolt below it. If the product of every volume into the mean fiber-length of its representative disc be obtained, and the sum of all such products be divided by the total volume of wood, the quotient will be the mean fiber-length for the tree.

The determination of the true mean fiber-length of the disc is the most serious operation in this procedure. Usually the mean fiber-length is not the only object of such a series of operations. The variation in fiber-length throughout the tree is also a matter of importance. The length of fibers varies according to their height in the tree. Most notable, however, is the variation which takes place as the tree grows older. Taking such a disc as has been referred to one finds that the wood next the pith has the shortest fibers and that the fiber-length increases as one proceeds towards the bark. If the tree is an old mature specimen this variation in fiber-length may cease to be an increase and may even become a slight decrease before the bark is reached. Indeed one may say that a mature tree is one whose recently added fibers are no longer than those laid down in previous seasons.

In taking samples of wood from the discs it has been customary to remove these from certain positions along a radius having the pith as center. The positions are chosen according to their distances from the pith or from the bark, these distances being measured either in inches or by the number of annual rings. Usually, however, the distance of a sample from the pith in inches is known.

In sampling along a radius in this way it is evidently assumed that the fibers at any given point on the radius are representative of a zone whose geometrical center is at the pith.

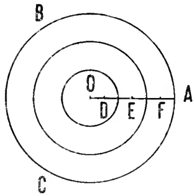
At each selected point on the radius a sample of wood is taken and disintegrated, fifty fibers being measured and the mean fiber-length thus determined.

The question now arises, how should the mean fiber-length for the disc be determined from the fiber-lengths at points along the radius?

The practice has been to add all the determinations together and divide the sum by the number of determinations.

It is not hard to see how inaccurate such a procedure would be.

Suppose the circle A B C represent a disc



which has been sampled at D, E, and F on the radius OA and gave a mean fiber-length of 1 mm. at D, 2 mm. at E and 3 mm. at F. The mean according to the usual procedure would be

$$(1 + 2 + 3) : 3 = 2 \text{ mm.}$$

If D, E, and F were at 1/6, 1/2, and 5/6 of the distance OA being equally spaced it would be fair to assume that they represented zones of equal width, viz: with radii 0 and 1/3, 1/3, and 2/3, 2/3, and 1. One would have the disc divided into three zones each with its own fiber-length.

The areas of the zones would be

$$\pi \left(\tfrac{1}{3}\right)^2 = .349$$

$$\pi \left(\tfrac{2}{3}\right)^2 - \pi \left(\tfrac{1}{3}\right)^2 = 1.047$$

$$\pi (1)^2 - \pi \left(\tfrac{2}{3}\right)^2 = 1.746$$

$$\text{Total area of disc } \pi (1)^2 = 3.142$$

In determining the mean fiber-length of the disc one has given the zone having a fiber-length of 3 mm. no more influence on the result than the zone having a fiber-length of 1 mm. although its area was five times as large as that of the latter.

Obviously if one has several areas with its own fiber-length, the true mean must be obtained by taking into account the extent of those areas. The correct procedure is to multiply each area by its fiber-length, add together the products and divide the sum by the total area. Thus in our example

$$
\begin{array}{lcl}
.349 \times 1 & = & .349 \\
1.047 \times 2 & = & 2.094 \\
1.746 \times 3 & = & 5.238 \\
\hline
 & & 7.681 \\
\end{array}
$$

$$7.681 : 3.142 = 2.445$$

Thus we get 2.445 for the mean fiber-length of disc, instead of 2 which the former method gave.

This last example is given for argument's sake only and although more accurate than the previous one is neither very practical nor formally correct. It does not follow that a sample taken from a position half way across the breadth of a zone (as at D, E, or F) would provide fibers of a length equal to the mean for the zone. Indeed the argument implies the contrary.

A practical method would be to sample the wood at known distances along the radius and to determine the mean fiber-length at those points. One would then have a number of zones or annuli and the mean fiber-lengths at their inner and outer circumferences.

Such an annulus, lying as it does between the circumferences of two circles whose radii may be called r_1 and r_2 will have an area equal to

$$\pi (r_2^{\,2} - r_1^{\,2})$$

As the circumferences bounding the annulus pass through points at which fibers were measured, an approximate relation of fiber-length to radius may be established for each annulus. A necessary assumption here is that the curve representing fiber-lengths plotted against radii is a straight line for any given annulus, or

$$L - c \propto r$$

where L is the fiber-length, r the radius and c a constant of a given annulus, whence

$$L = kr + c$$

where k is another constant applying only to a given annulus.

If L_1, L_2 are the fiber-lengths at the points denoted by r_1, r_2 then

$$k = \frac{L_2 - L_1}{r_2 - r_1} \qquad (a)$$

$$c = L_1 - \frac{L_2 - L_1}{r_2 - r_1} r_1$$

$$= \frac{L_1 r_2 - L_2 r_1}{r_2 - r_1} \qquad (b)$$

The area of an indefinitely narrow annulus

$$= 2\pi r \quad dr$$

The product of this area into its proper fiber-length

$$= 2\pi r \quad dr$$
$$= 2\pi r\,(kr + c)\,dr$$

The product of any annulus defined by r_1 and r_2 into its fiber-length which varies between L_1 and L_2 may be obtained by integration of this expression, as follows:

$$\int_{r_1}^{r_2} 2\pi r \quad dr \quad (kr + c)$$

$$\int_{r_1}^{r_2} 2\pi k^{2}\,dr + 2\pi r \quad c \quad dr$$

$$2\pi\left[\frac{kr^{3}}{3} + \frac{r^{2}}{2}c\right]_{r_1}^{r_2}.$$

$$2\pi\left\{\left(\frac{k}{3}(r_2^{3} - r_1^{3}) + \frac{c}{2}(r_2^{2} - r_1^{2})\right)\right\}$$

Substituting values of k and c given by (*a*) and (*b*) this becomes

$$\frac{\pi}{3}\left\{L_2(2r_2 + r_1) + L_1(2r_1 + r_2)\right\}(r_2 - r_1) \qquad (c)$$

Dividing this value by the area of the annulus we obtain the mean fiber-length for the annulus

$$= \frac{1}{3}\left\{L_2(2r_2 + r_1) + L_1(2r_1 + r_2)\right\}\frac{1}{r_2 + r_1} \qquad (d)$$

The sum of all such products (*c*) throughout the disc divided by the total area of the disc gives the mean fiber-length for the disc

$$\frac{1}{3R^{2}}\sum_{r=o}^{r=R}\left[\left\{L_n(2r_n + r_{n-1}) + L_{n-1}(2r_{n-1} + r_n)\right\}(r_n - r_{n-1})\right]; \qquad (e)$$

These formulæ have other applications than those of fiber-length.

I believe that nearly all published determinations of the mean values for a tree of those properties which can be expressed numerically, whether chemical, physical or mechanical, have been made on the assumption that one sample was as good as another and carried as much weight on the result whether it represented a small volume surrounding the pith or a hollow cylinder next the bark of considerable volume. A consideration of the argument of this paper may therefore suggest improvements in the computation of results of tests of properties of wood other than fiber-length.

VOLUME INCREMENT ON CUT-OVER PULPWOOD LANDS

By E. F. McCarthy and W. M. Robertson

Commission of Conservation, Ottawa

There are few systems of cutting in spruce and balsam fir forest which have not already had a practical trial.

Cuttings of every degrees of intensity, on every type, have been made and a sufficient period has since elapsed to show the effect on reproduction, mortality of the remaining stand, fire risk, and acceleration of growth. Studies of such cut-over land will furnish facts which cannot be secured from virgin lands, and the lessons so learned may be applied either to similar types of virgin forest or to the cut-over area which is increasing in Eastern Canada at the rate of over a million and a half acres annually.

The problem is two-fold: the study of cut-over land to determine the influence of such cutting, and the study of virgin land to determine maturity, that is, the time when profitable growth is no longer accruing in the virgin forest.

The study of volume increment in many-aged stands has been discussed in various phases by Cary (1), Chandler (2), Chapman (3), Fernow (4), Moore (5), and Stetson (6), but in nearly all instances the stand under consideration was virgin in character and the methods do not consider the several agencies of destruction which, after cutting, practically offset growth for a period of years. This discussion presents a method of study of cut-over land which takes cognizance of present growth and mortality, and from these suggests a method of volume regulation.

SELECTION OF THE AREA

Many stands in the northern forest are adapted to management by selection or shelterwood systems for the continuous production of pulpwood. Where the softwood has a good representation in all size classes and is free from serious interference by the tolerant hardwoods, it needs only protection and conservative cutting to yield a good second crop. Such stands may be found in the swamp and flat land types of the tolerant hardwood belt and in all parts of the north-

ern forest region where white birch and aspen constitute the hardwood element of the forest. On such sites, spruce and balsam will respond favorably to selection methods, with a severity of cutting determined by the exposure and the soundness of the timber.

Intensive study of large areas of cut-over land is impracticable for the same reasons that intensive cruising methods have not found favor where the yield per acre is low and cost of logging high. It is necessary to limit the study, therefore, to a sample area of sufficient size to give good average results and later apply the results to a more extended area of similar character. The area selected for study should have been cut at least ten years previously; and if parts of it have been cut heavily twice, additional information concerning mortality and growth can be acquired.

Such a study of the cut-over land was made during the summer of 1920 in two townships in the Algoma district of Ontario. The results obtained are to be used in regulating the cut of eleven other townships in the same (Goulais River) watershed. Data were obtained by a 5-per-cent strip survey on about 13,000 acres of cut-over land. This was sufficient to give good arithmetical averages for all tables without the construction of curves. The same methods were applied to the study of certain areas in New Brunswick, and the illustrative data are taken from this latter study.

ESSENTIAL DATA

Determination of volume increment by this method requires stand tables, volume tables, a record of mortality and measurement of diameter growth. The study of the amount of advanced growth and reproduction is not necessary to determine the volume increment for the period elapsing before the next cut, but it is essential to determine the character of the forest which will be left following the next cut, as well as to show whether the opening of the forest has been favorable to regeneration of the softwood type.

Uniformity in classification of all data is required so that the results obtained in stand tables, volume tables and increment borings may be combined for computation of volume increment. The study of any average area of northern forest becomes a group of separate studies as numerous as the distinct type associations or recognized sites.

Any attempt to learn the natural laws controlling growth and reproduction, rather than the average facts for the area as a whole, will

lead to excessive division of the data, which, besides adding to the cost, will reduce the accuracy of the results.

Stand Tables.—The caliper record will set the limit upon division of data, since it must cover sufficient acreage in each type and site division to give an even gradation of numbers in the stand table without resort to curves to even off the irregularities. Softwoods should be calipered at least to the next inch class lower than that covered by the borings. The limit will depend on the rapidity of growth of the smaller size classes. It is essential that the stand table, in a study of pulpwood species, shall show the numbers in all inch classes down to the size counted as advanced growth and reproduction, though the lower diameter classes may be recorded from a smaller percentage of the total area.

Volume Tables.—In the absence of volume growth tables based on complete stem analyses, volume tables are essential for the computation of yield. They should be constructed on the basis of diameter alone on the area studied or otherwise should be checked by hypsometer measurements from volume tables based on both height and diameter. Total volume in cubic feet offers the best medium for comparison of results in pulpwood species.

Mortality Record.—The destruction of trees left after a logging operation, by various natural agencies, has been commonly observed, and is accepted as unavoidable to a certain extent. Little effort has been made to take account of this loss, which has been largely underrated. Other mortality than that of healthy trees windthrown, such as those gradually dying by decay, insect attack and exposure, cannot be accurately judged even if under constant observation. Mortality offsets growth, and is quite largely responsible for the undervaluation of cut-over pulpwood land, since growth will eventually exceed the mortality and produce a rapid net increment.

A sufficiently accurate estimate of mortality since a cutting operation can be made by comparing the rate of decay in killed timber with that in slash left by the logging operation. In this way the loss for the first decade may be determined, and the second decade following a logging operation will usually show less down timber than the first decade, due to stabilization of the remaining stand. The study of cut-over lands in the Algoma district of Ontario showed a mortality in ten years nearly equal to the cut. Its causes were chiefly the decay

at the base of the tree and in the roots, action of boring insects on trees weakened by exposure and final overthrow by wind.

Annual loss can be determined only by annual survey and this extra cost is not justified on extensive areas. The determination of loss in successive decades will serve every purpose, and will very probably decrease as more care is used in disposing of slash, since this will reduce the breeding places for insects. The loss will also decrease as the timber grows more rapidly by virtue of increased growing space, and overcomes the influence of decay.

Diameter Growth.—Diameter increment measurements can be best taken by boring at breast height in soft woods up to 14 inches in diameter, and should be made systematically in conjunction with the caliper record, using the same distribution of types and tree classes. Borings should be made on at least 100 trees for each inch class in a given species to give good averages. Classification of trees within a species is only made necessary by severe suppression or injury to some individuals. If the stand left after logging is open, the effect of ten years' growth is to render identification of suppressed trees difficult. This causes lack of uniformity between the stand table and borings, and makes the separation of free and suppressed trees inadvisable.

Measurement may be made of the number of rings in the last inch, or half-inch of radius, or the width in inches of the growth of a given period of years may be taken. After a series of measurements have been collected to show the trend of growth, determination can be made as to the most useful measurement for a given purpose. A measurement of diameter increment on any inch class, which includes two rates of growth, will not be useful for prediction of future growth, since it does not give a representative average. The field form attached shows the range of possible measurements on cut-over types where acceleration has taken place.

The error due to oblique boring can be made negligible for measurements of the outer inch or half-inch, by care in alignment of the instrument. Borings made at breast height will avoid the root swelling on trees up to 14 inches, while larger spruce and balsam trees which survive a pulpwood logging operation are usually defective and are not making appreciable net growth.

The relation of height to diameter can be determined on bored trees by hypsometer measurement. Position of the crown with its

resultant influence on distribution of wood in the tree bole will require specific study for each species to finally settle the degree of accuracy of diameter accretion measurements made at breast height. Studies of complete stems following a logging operation will not bring out this relation unless a cutting has taken place previously and has caused sudden acceleration of the stand. Check of height on diameter will give sufficiently accurate results if diameter increment measurements are applied to local volume tables.

USE OF GROWTH DATA

Similar growth measurements for a given species may be arithmetically averaged and plotted by diameter classes from a common zero base line as shown in figure 1. This will bring out most strongly the irregularities due to errors, as well as the comparison of growth of the inch class.

Since the final purpose is the determination of volume increment for a fixed period of years, it is necessary to have a continuous growth curve which can be read to any year and fraction of inch. The curve shown in figure 2 is plotted directly from values in figure 1. The 14.7 years shown in figure 1 is the growth period required for a 4-inch tree to become a 5-inch tree. This time was plotted on the 5-inch co-ordinate in figure 2. The fifteen years required by the average 5-inch tree to reach 6 inches as shown in figure 1 was added to 14.7 years and the resulting 29.7 years was plotted on the 6-inch co-ordinate. The other values for the curve were computed in a similar way and plotted. The resulting curve represents neither the diameter growth of a single tree nor the average for the stand through the period of years shown, but shows the contemporary growth of all diameter classes for a short period up to the time of measurement.

This method of determining the diameter increment of any inch class differs from that used by Stetson (6) and Chandler (2), since one measurement only is made on each tree, and the growth predicted for any inch class is that actually attained by the next higher inch class. It has the advantage of not carrying forward any error due to difference in growth rate between the last half-inch of radius and the last inch of radius, due to suppression or release during that period. It assumes a stabilized rate of growth for at least an inch of diameter, and is liable to error if projected too far into the future.

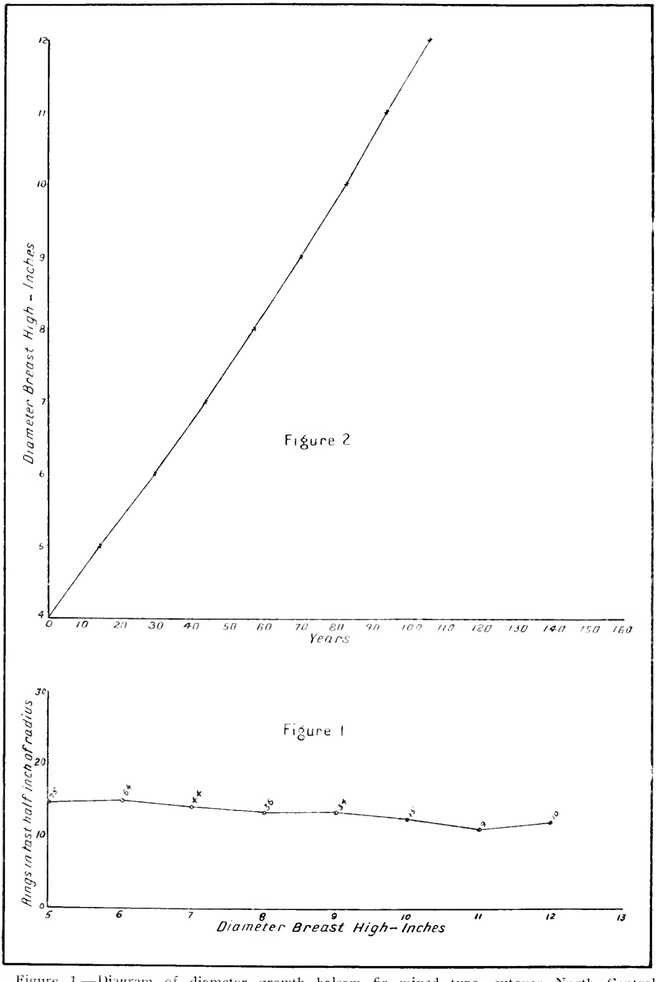


Figure 1.—Diagram of diameter growth balsam fir mixed type—cutover North Central New Brunswick. Figures on the graph represent the number of trees used to locate each point.

Figure 2.—Same data extended into a continuous growth curve. Points connected by straight lines in actual position.

Having obtained the volume of any inch class at the time of measurement by application of the volume and number per acre for that inch class, the *net* volume increment for that inch class for the past decade and *gross* volume increment for the succeeding decade may be obtained.

The diameter of any inch class for the previous decade can be secured by reading it from the growth curve for any fractional inch, and the volume for any fractional inch class can be read from the volume curve.

A rough volume regulation of virgin lands may be made following a study of cut-over land in the vicinity. Having determined the available merchantable pulpwood on the working unit, the annual cut may be fixed to yield an equal or better cut in such period of years as is determined from the study of the cut-over land. Comparison should be made not only of merchantable volume but of type acreage to determine whether the conditions on the virgin area are similar to the original conditions on the cut-over land. Detailed study of virgin forest will serve later to give an important check on mortality, but other factors are too liable to change to make such studies of value.

PRESSLER BORING RECORDS

Date.................. Strip No.............. Course............... Locality..............

Date of cut................................. Tallied by..................................

Species	Type	Other Class'n	D. B. H.	D. S. H.	(1)	(2)	(3)	(4)	(5)	Height	Remarks

1. Rings in last ½ inch of radius.
2. Rings in last inch of radius.
3. Growth (inches) for the first ten years since the cut.
4. Growth (inches) for the ten years previous to the cut.
5. Entire growth (inches) since the cut.

LITERATURE CITED

1. Cary, Austin.—Excerpt from Report of Forest Commissioner of Maine for 1896. Pp. 26-27, 122-128, and Appendix, p. 21 and following.
2. Chandler, B. A.—Notes on a Method of Studying Current Growth Per Cent. Forestry Quarterly, Vol. XIV, pp, 453-460.
3. Chapman, H. H.—A Method of Investigating Yield per Acre in Many-aged Stands. Forestry Quarterly, Vol. X, pp. 458-469.
4. Fernow, B. E.—Notes on Increment of Spruce in West Virginia and Fire Losses. Forestry Quarterly, Vol. III, pp. 346-348.
5. Moore, Barrington.—Yield in Uneven-aged Stands. Proceedings of Society of American Foresters, Vol. IX, pp. 216-228.
6. Stetson, J. C.—Some Suggestions on Predicting Growth for Short Periods. Forestry Quarterly, Vol. VIII, pp. 326-331.

INDIAN TIMBERLANDS

By J. P. Kinney

In Charge of Timberlands, Office of Indian Affairs

I read with much interest the article by E. A. Sherman in the April number of the Journal, entitled "A Plan for the Disposition of Indian Timberlands."

References in this article to certain recommendations that appear to have been made by the Forest Service of the Department of Agriculture to the Committee on Indian Affairs in the House of Representatives give the article some color as an official discussion of Indian timberlands. However, I assume that it was not Mr. Sherman's intention to present this subject as an official in the Forest Service but merely as a member of the Society of American Foresters, an association that should, of course, be deeply interested in all questions relative to the maintenance of an adequate supply of timber in the United States.

While there are several features in Mr. Sherman's plan to which I, as an official in the Indian Service, might feel impelled to take exception, I am writing now solely from the standpoint of a member of the Society of American Foresters who has a rather intimate acquaintance with the intricate problems of Indian administration and particularly of the forestry branch of that Service. In attempting to present certain phases of the problem from this detached point of view, I must necessarily refer to my connection with the Indian Service; but I desire to disclaim any intention of presenting official comments or suggestions.

Mr. Sherman's article in the Journal indicated a belief on his part that the only manner in which the non-agricultural lands of the various Indian Reservations could be maintained in a state of efficient use, either as protecting forests or as timber production forests, would be through the inclusion of such lands within the National Forests in the near future. A critical study of the whole situation might lead Mr. Sherman to very material qualifications of this view. While I believe that large areas, properly classifiable as primarily valuable for water conservation purposes, could be immediately attached to adjacent

National Forests with the full protection of the interests of the Indian owners, there are other reservations as to which the inclusion within National Forests of all lands of this character would seriously affect the grazing interests of the Indians with no attendant advantage from the standpoint of water conservation or the protection of the forest growth. Foresters should not sacrifice the well-established rights of men on the altar of speculative theory as to the rights of trees.

When due consideration is given to the cultural status of the Indian, some doubt may arise as to whether the payment to the Indians of the valuation that would in all probability be placed upon such lands by the Forest Service would really compensate the owners for the annoyance and enforced modification of life that must result from a quasi-seizure of their lands by the Federal Government. Many Americans entertain the very erroneous view that the individuals in every tribe or band of Indians, to whom allotments have been made, have received all that they need to enable them to achieve economic independence. This view is based upon egregious misunderstanding of the facts. There are hundreds, and possibly thousands, of instances in which Indians have been given individual allotments of 80 or 160 acres each upon which it is utterly impossible for an Indian, or a white man, to make a livelihood. Such individuals must on many reservations rely upon the privilege of grazing stock on tribal land to obtain a living. Would not the expropriation of these tribal lands necessarily increase the poverty and distress already too prevalent among the Indians? Having taken from the redman the privilege of subsisting through the pursuit and capture of wild animals, should we also snatch from him the opportunity of obtaining a living through his slowly acquired knowledge of the live stock industry? Any man familiar with the Indian problem knows that the average Indian cannot today compete with the average white man in industrial enterprises. Will not the grazing interests of the Indian inevitably suffer when his grazing lands are incorporated in the National Forests, in which all must stand on an equal basis?

Why should not the United States Government maintain the present status of these lands as Indian tribal lands and at the same time protect them from forest fires so as to preserve fully their character as protection forests and improve their value as production forests? This is what I and those working with me in the forestry branch of the Indian Service have been very earnestly trying to do during the past decade. I believe our efforts have been attended with a fair degree of success.

Our methods have been somewhat different from those pursued by the Forest Service of the Department of Agriculture for reasons that are neither inexplicable nor difficult of comprehension. I know well with what zeal for the public interest and devotion to duty my associates have done their work. Although the avenues to publicity as to their accomplishments in forest fire suppression and economic timber-sale administration are very restricted, I am confident that any impartial observer would commend the results attained.

Men engaged in forestry work in the Indian Service since 1910 have received co-operation and friendly support from many men connected with the Forest Service of the Department of Agriculture and the generous sympathy and assistance of individual foresters not connected with the Federal service, but no recognition of their work has come from the Society of American Foresters. I am not presenting a complaint. To me personally it matters not that an enterprise with which I have been connected has been one of "homely joys and destiny obscure." My pronounced egotism makes me about as impervious to praise as to criticism. I had never given more than a passing thought to this significant silence of the Society until I read Mr. Sherman's article in the JOURNAL. Then the thought occurred to me: "If the members of this Society are primarily interested in the maintenance of the forest cover on these lands within Indian Reservations, why is it that the Society never has and does not now lend its support to the Indian Service in the effort that the said Service has been making during the past ten years to preserve the forest character of lands chiefly valuable as protection forests or for the production of timber?" I conceive that the Society of American Foresters should be more keenly interested in the broad phases of sound forestry practice than in the mere expansion of the area administered as National Forests. If such be the case the Society should certainly stand ready to sponsor any movement that aims at the furthering of sound forest management on Indian lands.

If, as indicated above, the immediate inclusion of all non-agricultural lands on certain Indian reservations within National Forests is inadvisable from economic and moral standpoints, why cannot the Society lend its moral support to the administration of these lands as Indian forest lands? If there are non-agricultural Indian lands about to be opened to private entry or purchase and the immediate inclusion of these lands within National Forests is not practicable, would it not be

wise for the Society to take affirmative action toward assisting the Indian Service in preventing the segregation of ownership in such manner as to render fire protection improbable? The Indian Service is today confronted with specific problems of this character, but the Society vouchsafes neither assistance nor sympathy. Quite to the contrary, in a recent canvass of its whole membership for an unqualified vote of preference between the Capper Bill and the Snell Bill, the Society officially represented that the latter bill is essentially directed to a policy of restricted Federal control of forest resources; while as a matter of fact the Snell Bill, in providing for a most comprehensive extension of Federal administration in general, contemplates the transfer of nearly all Indian timber holdings to the status of National Forests. The unfortunate and misleading presentation in this circular letter and questionnaire probably did not bring any different result than would have been obtained if it had been made clear that the Snell Bill contemplated the addition of many millions of acres of Indian forest lands to the National Forests. The point to which I wish to direct attention is that the Society apparently fails to recognize that these Indian lands are already being administered in accordance with the principles of scientific forestry.

While the immediate inclusion of certain Indian timberlands within National Forests may be advisable and the ultimate inclusion of other areas may be practicable, irreparable damage may be done before these lands can be given that status. I believe that few, if any, members of the Society would knowingly deprive the Indian of that which is rightfully his. I believe that the ideal of all members is the advancement of the cause of forestry in America. I am confident that with a full understanding of the facts all would exhibit an interest in the success of forest administration on Indian lands in any practicable manner. Surely the inclusion of Indian timberlands within National Forests cannot be the *sine qua non* of professional interest!

YELLOW PINE REPRODUCTION:

Comments on Factors Affecting Its Establishment

By Walter J. Perry

Probably every forester who has worked in pine timber, and especially where various age classes are represented, has observed the tendency toward a grouping of certain age classes with relation to the parent tree. This often observed fact gives rise to the saying among woodsmen—"they seed before they die."

This saying, while literally true, is the result of a misconception of cause and effect. The reason behind the fact is, of course, that while the tree is in its prime, and while full-crowned and drawing heavily upon the soil moisture, there is but slight chance of seed germinating, or rather of growing very near the parent tree. This is owing to some extent to heavy shade, but to a much greater extent to a lack of sufficient soil moisture to sustain them after germination. Therefore the oldest offspring of these old trees are found as sturdy black jacks which spring up some distance from the parent trees, while the second "wave" more or less completely fills the space about to be vacated by the declining mother tree.

In open stands, except for some small groups, these old trees are too short and limby to produce either a good quantity or quality of lumber. (The reason is plainly seen in the open nature of the stand in their youth.) Going a step farther on this line, are we not then dependent for our next considerable crop of timber not to these first black jacks which sprung up, but on the second "wave" of reproduction which is thick enough to cause upward growth and produce 3-4-log trees? If this is so, it follows that in marking a stand we must make ample provision for bountiful reseeding of the area where reproduction is lacking and not be content with an occasional seedling here and there.

Not only must reseeding be plentiful, *it must be prompt.* On cutting a stand of yellow pine, conditions grow progressively less favorable with time to the establishment of reproduction. My observations confirm me absolutely in this belief.

I would cite a case in that cut-over land along the east border of the Carson Forest south of the town of Tres Piedras. This land, several hundreds of acres in extent, bore a stand of pure yellow pine,

and was cut over some 30 years or more ago. The only reproduction that survived after the cutting was of considerable size and has since grown into good-sized black jacks. Many of these young trees are now bearing, as are also the scattered yellow pines that were left. There are, however, practically no new seedlings—not an average of one per acre over large areas!

On this area logging was done with cattle; tree tops were left as they fell; trees left are frequently spaced about as we leave seed trees under our marking policy; there has been no fire since the cutting; the area has probably never been overgrazed, especially by cattle, for lack of stock water, and to my knowledge has been much undergrazed the past 8 years for the same reason; the tract is lightly grazed, and for short periods, both by cattle and sheep, and there is a very heavy cover of bunch grass and oak brush. This area lies slightly above 8,000 feet with a gentle slope to the north and northeast. The soil is clayey and carries but few stones. Why is there no reproduction? I cannot believe under the circumstances that sheep grazing is altogether responsible, and especially in recent years. Was the land *undergrazed* immediately following the cutting? Probably so.

There was bunch grass there when the timber was cut, and tree tops lie as they fell. Probably the grass was so protected from grazing by horses and cattle—sheep would not eat it in any case—that by its rank growth it kept out pine seedlings, but this does not account for the equal lack of them in the openings.

General conditions before the cutting are easily ascertainable and were about as follows: Rather open stand of mature pine and black jacks and scattered seedlings; bunch grass and oak brush between; clay soil; small amount of humus on ground; water run-off was rapid and land rather dry in consequence. Then came a heavy cutting resulting in a very thin stand permitting the full drying effects of sun and wind on an already dry soil and the surface was promptly baked. Probably there was no seed produced the year of the cutting, nor the following year, or there would almost certainly have been some reproduction. The opening of the stand greatly favored the existing bunch grass and oak, even old tree sites being promptly occupied, still further reducing the chances of germination by failure of pine seed to reach the ground, and with all the advantage on the side of the bunch grass and oak in a competition for soil moisture if any seedlings started. Conditions grew progressively worse from year to year. There are no seedlings.

Left to nature, this tract may come back in the course of several hundreds of years, and it may never come back. This for several reasons, the chief of which are: (1) The soil is much harder and more thoroughly baked than before the timber was stripped from it, and the only seedlings that could possibly start might be classed as accidental, being planted by the hoof of some animal or possibly by falling into a sun crack in the earth. (2) This accidental seedling must then depend for its continued existence upon an almost unimaginable series of fortunate circumstances to assist it past the dangers of a parching sun, unchecked winds, and competition for soil moisture with the grass and oak brush, to say nothing of grazing and fire, both of which are however more or less under our control.

Apparently a condition has been set up here under which it is impossible for the pine to reproduce. Are we daily bringing about similar conditions elsewhere? The Forest Service, of course, had nothing to do with the cutting of the above area, but that is not earthly reason why we should fail to observe the results and endeavor to profit by our observations.

All the foregoing is old stuff. Many of us, doubtless, have made the same observations whether we kept them under our hats or put them on paper. The cold, hard fact is we are *not* securing satisfactory reproduction in this type. Another equally stubborn fact is we *must* do so. There are two alternatives, neither very pleasant to contemplate. (1) Quit cutting the timber, and (2) frankly admit to the people that we are in the timber mining business.

We will resort to neither alternative, but will, I believe, be forced to amend our marking policy somewhat, as well as apply the emergency brakes good and hard to certain classes of grazing.

But to tackle the eternal problem of "how to secure yellow pine reproduction." In the first place, we must realize fully that we are working under a set of conditions here in our Southwest that are probably parallel nowhere else on earth where forestry is practiced. Therefore we cannot afford to rush blindly forward using methods foreign to our country and local conditions, and of the favorable outcome of which we are not at all assured. We have no right to jeopardize the people's interest for generations to come in further exploration of a trail which it now appears certain is leading up a blind canyon. We are burning our bridges behind us.

It has been noted that there is a strong tendency for seedlings to come in around trees dying or newly dead. Theoretically these seed-

lings should come in around our cut stumps just as well, and actually do so, provided an abundance of seed is available and *promptly available*, as usually happens in nature. That is, if seed is promptly deposited in the moisture-retaining humus around the stumps before grass comes in, there will very probably result a stand of seedlings sufficiently thick to produce a complete stand of shapely and commercially valuable trees, while if sole dependence for seed is placed in small, sparse, and immature trees to cover large areas, the site will most likely be taken by grass and brush with only an occasional accidental pine. If restocking is not prompt it may, for the above reasons, be delayed an indefinite time, possibly a tree generation or more, and this regardless of the best grazing practice.

This argues for light marking on unfavorable sites and where reproduction is backward, even at the sacrifice of some timber which may go to waste before another cutting. I am convinced that this is the only way on certain stubborn sites.

If the stand is so light that the retention of sufficient seed trees would render the cutting of the remainder unprofitable, it should be allowed to stand uncut, and steps taken to secure reproduction *before cutting* and to protect it absolutely after cutting. It would appear better for the people to lose the *lumber* value of this timber, or a part of it, rather than be deprived of the potential value of the entire forest for possibly some hundreds of years.

In addition to general observations extending over quite a number of years, I have recently made an intensive study of yellow pine reproduction on 10 representative plots on an area cut over in 1916. This cutting is still too recent to furnish an ideal field for the study perhaps, but it is the best available. My purpose in making the study was to determine the effect upon reproduction of: (1) Seed trees, their class and spacing, (2) brush disposal, and (3) grazing of cattle and of sheep. The conditions as found, with comments and conclusions, are appended.

The net result of my observations is the absolute conviction that yellow pine reproduction after cutting depends upon the three following points which are given in the order of their importance as I value them: (1) Seeding, (2) grazing, and (3) brush disposal.

Seed Trees: These should be thrifty full-crowned intermediate trees, with large black jacks as second choice. They should be so spaced that no tree would be depended on to seed an area greater than the "fall" of the tree; that is, a circle the radius of which would equal the height of the tree. In fact, it will not properly seed a *circle* of

this size, though the seeded area might equal the circle. The area actually seeded will be roughly triangular or pennant-shaped, according to the direction and strength of the prevailing winds, and this fact must be taken into account. *Prompt seeding* is necessary, hence the necessity for seed trees already in full bearing habit.

Grazing: (*a*) Cattle grazing when not to absolute excess distinctly favors reproduction by keeping down coarse vegetation, and should be encouraged both before and after cutting. Practically the only damage done by cattle is cropping a few of the largest seedlings when forage is covered by snow. Necessarily, some small seedlings are tramped out, but this damage is probably negligible. Bulls destroy some larger seedlings by horning. (*b*) Sheep grazing is absolutely detrimental in any pine forest not already fully stocked with trees two feet or more in height. They must be excluded from cut-over lands, and should be excluded some years in advance of cutting unless satisfactory reproduction is already present. Sheep feed not upon bunch grass, but upon the soft grasses, herbs and young trees found among it. Therefore, even if they did no damage to the young trees, they would not keep down the bunch grass.

Brush Disposal: In bunch-grass country, any form of brush disposal which will prevent reasonably close grazing by cattle will more or less effectually prevent reproduction. Brush should be burned, with compact piling as second choice. Upon dry barren ridges and similar south slopes, however, it should be thinly scattered in order to protect the soil and encourage the growth of grass or any other soil-building and soil-holding vegetation. When brush is roughly scattered without close and flat lopping the effect is to prevent sufficiently close grazing. No seedlings grow under pulled tops or brush piles, and only among the thinnest of scattered brush by reason either of too much shade or too much competition with grasses and weeds.

The matter of securing reproduction prior to cutting is not a dream. I believe it can be done practically anywhere. On the Carson Forest we have large areas of pine with absolutely no reproduction, save it be a few of the 1919 crop which the sheep haven't yet gotten to. Also, on areas not grazed by sheep, we have large tracts already plentifully stocked with pine from pole size up, and the forest floor literally sprinkled with seedlings two to six or eight years old. On these latter areas we could cut every merchantable-sized tree and run no risk except that of fire—entirely too great a risk, however—and be assured of a stand to promptly take its place.

As I see it, the formula for securing yellow pine reproduction can be expressed in ten words: Chase the sheep; graze cattle; leave seed trees; burn brush.

SEEDLING STUDIES

Plots taken across a series of east-running ridges and draws. Altitude, 7,800. Pure stand of yellow pine. Cutting in 1916.

Plot No. 1

Exposure: Gentle N.E. slope in open draw.
Timber: Open stand mature trees. Some park land.
Cutting: None.
Soil quality: Excellent. Deep alluvial.
Soil moisture: Excellent.
Ground cover: Scanty grama. No sod. Pingue and weeds.
Seed trees: Large, mature and intermediate in groups.
Brush disposal: No brush.
Grazing, C&H: Overgrazed.
Grazing, S&G: Formerly much overgrazed. Lambing ground.
Reproduction: 8-15 years plentiful on lee side (east) of trees. Seed cast 90 feet from trees. A very few seedlings about 5 years old. Practically all of the seedlings have been badly damaged by sheep. Some cropped by cattle. Many young trees putting up a second or even a third leader. Many dead stubs. None coming in over parks. Some damage by horning of cattle.

Conclusions: Trees have seeded heavily as far as they could reach. Good soil and moisture enabled some seedlings to survive. All would have been destroyed on poorer site. Plot has been badly overgrazed by sheep: is still overgrazed by cattle, especially in winter. Seed trees have seeded according to prevailing winds. Land in good shape for reproduction if stock were excluded.

Plot No. 2

Exposure: E. 12 per cent slope.
Timber: Mature and intermediate.
Cutting: Light.
Soil quality: Good. Alluvial. Some stones.
Soil moisture: Fair.
Ground cover: Pine grass and various bunch grasses very abundant where protected by tops and heavy brush.
Seed trees: Intermediate. Plentiful.
Brush disposal: Pulled or piled (both methods used).
Grazing, C&H: Fully grazed except for brush protected areas.
Grazing, S&G: Too heavy in former years. None recently.

Reproduction: Some 6-10 year seedlings where protected by light brush but none in openings. 2-year seedlings coming in quite freely on old tree sites and in openings among brush where grass is well grazed. None in brush.

Conclusions: Good seed trees well spaced. Pre-existent seedlings able to hold their own against grass in thinner brush. Those not so protected have been killed by sheep since cutting. Later seedlings not able to survive under brush and grass.

Plot No. 3

Exposure: South slope, 20 per cent, and top of ridge.
Timber: Small. Mature. Small clump of poles, not seeding.
Cutting: Fairly heavy.
Soil quality: Rather poor. Some rock.
Soil moisture: Very poor on slope.
Ground cover: Scant grass and pingue. 4-year-old burn on slope.
Seed trees: Mature. Bearing habit. Upper edge of burn. On edge of burn slender seed trees blown down.
Brush disposal: Roughly scattered. Mostly burned.
Grazing, C&H: Complete utilization except in brush.
Grazing, S&G: None very recently.
Reproduction: Absolutely none on slope. 6-8 year old fairly plentiful on ridge above burn. Also 2-year old coming in freely on well grazed spots on ridge.

Conclusions: Not enough trees for seed and shade. Exposed (burned) soil too dry. Grass and herbage will precede trees.

Plot No. 4

Exposure: E. 10 per cent slope. Open valley exposed to west winds.
Timber: Mature. Very open. Bordering open valley to east.
Cutting: None.
Soil quality. A 1. Deep rich loam.
Soil moisture: Excellent.
Ground cover: Scant grama sod. No bunch grass. Small weeds
Seed trees: One large intermediate and one 40-foot black jack.
Brush disposal: None.
Grazing, C&H: Rather heavy.
Grazing, S&G: Very heavy in former years. None in past two years.
Reproduction: 8-12 years old almost complete on east side only of older tree for remarkable distance of 225 feet. Not nearly so good or far east below B. J. Younger reproduction practically none. Much evidence of sheep damage in dead stubs and second leaders. Now making rapid growth (16 inches in 1920).

Conclusions: Trees have seeded their normal area. Could not seed against prevailing winds to which they were fully exposed. Repro-

duction would have been entirely destroyed on a less favorable growing site. No seed in 1919.

Plot No. 5

Exposure: N. Gentle slope to open valley.
Timber: Large mature.
Cutting: 3 or 4 large trees cut.
Soil quality: Excellent black loam.
Soil moisture: Excellent.
Ground cover: Practically none. Bare humus soil.
Seed trees: Splendid 30-inch mature tree.
Brush disposal: Merely looped and left.
Grazing, C&H: Heavy.
Grazing, S&G: Very heavy in former years. None in past two years.
Reproduction: Outlying and pre-existent 6-15 years old good. Some few made their way in edges of brush. Around the stumps none except a very few originals. None since cutting. Much old sheep damage shown in forked and second and third leader trees. Conditions apparently ideal for reseeding except in tops.

Conclusions: Squirrels have destroyed seed since cutting. Chance seedlings destroyed by sheep first year. Seedlings existing at time of cutting will be destroyed by brush piles or heavy tops, more by merely lopping heavy tops than by leaving them as they fall. By their number and thrifty growth, due to ideal conditions, the existing seedlings survived the sheep damage, though their growth was much retarded. On dry and poor site probably none would have survived.

Plot No. 6

Exposure: N.E. Gentle slope.
Timber: Large mature.
Cutting: Five large trees cut.
Soil quality: Excellent.
Soil moisture: Excellent.
Ground cover: Scant grama and small weeds.
Seed trees: One splendid intermediate covering old stumps.
Brush disposal: Piled.
Grazing, C&H: Moderate.
Grazing, S&G: None recently.
Reproduction: Entirely lacking on old tree sites. Fairly good 6-10 years old on outlying well-grazed openings.

Conclusions: No seedlings under trees at time of cutting. Old tree sites in ideal condition for reseeding. Excellent seed tree in good bearing. Gray squirrels responsible for lack of seedlings since cutting. (Only 9 cones of a good crop escaped in 1920.)

Plot No. 7

Exposure: 20 per cent S. slope and top of ridge.
Timber: Mature.
Cutting: Heavy.
Soil quality: Fair.
Soil moisture: Fair on slope. Good on ridge.
Ground cover: Heavy bunch grass.
Seed trees: Intermediate and mature. Plentiful.
Brush disposal: Piled, but very loosely.
Grazing, C&H: Heavily grazed except in thick brush.
Grazing, S&G: None recently.
Reproduction: 6-year and younger very plentiful. Abundance of 2-year-old, both on old tree sites and in well-grazed openings in brush. A few of larger size coming up through lighter brush.

Conclusions: Good seed trees plentiful. Heavy grass kept down by cattle grazing. Ground promptly reseeded. Brush left on ground tends to conserve moisture. It should be thinly scattered on very dry sites, but better done away with on north and east exposure, as advantages are more than offset by increased fire danger and smothering of seedlings.

Plot No. 8

Exposure: North slope 15 per cent.
Timber: Mature.
Cutting: Very heavy.
Soil quality: Very good.
Soil moisture: Very good.
Ground cover: Good bunch grass. Scanty as yet on old tree sites.
Seed trees: Large intermediate.
Brush disposal: Lopped and left.
Grazing, C&H: Full utilization except in brush.
Grazing, S&G: None recently.
Reproduction: None older than cutting. 2-year-old coming in very plentifully around all old stumps and in all well-grazed openings in brush. Seedlings noticeably larger around stumps than in grassed areas.

Conclusions: Complete C&H grazing very desirable in heavily grassed area. Intermediate seed trees best for prompt and plentiful reseeding of cut-over areas. Lack of seedlings prior to cutting probably chargeable to sheep grazing. Seedlings cannot come in for many years where brush is heavy, and the amount and even age of the stand will be greatly affected thereby.

Plot No. 9

Exposure: N.E. slope 15 per cent.
Timber: Large and mature.
Cutting: (1) Tall clean bole grassed to stump. (2) Not grassed.
Soil quality: Very good.
Soil moisture: Very good.
Ground cover: Heavy bunch grass.
Seed trees: Large intermediate.
Brush disposal: Scattered, but heavy in places.
Grazing, C&H: Light.
Grazing, S&G: None recently.
Reproduction: Around tree site (1) none. Tree site (2) plentifully stocked with 2-year-old seedlings. Practically none in outlying grassed openings. None in brush.

Conclusions: Emphasizes desirability of heavier C&H grazing both before and after cutting, and of prompt reseeding around stumps. Outlying reproduction was probably destroyed by sheep before cutting.

Plot No. 10

Exposure: Gentle N.E. slope.
Timber: Large mature.
Cutting: Heavy.
Soil quality: Excellent.
Soil moisture: Excellent.
Ground cover: Light grama grass, except on burn.
Seed trees: 2 fair intermediate and 1 B. J. A tree at either corner of a right triangle slightly above ½ acre.
Brush disposal: Brush burned as it lay in center of triangle.
Grazing, C&H: Moderate.
Grazing, S&G: None recently.
Reproduction: Some 5-year and plentiful 2-year-old seedlings on normal seeding area of trees. Entirely lacking around center of triangle on old burn.

Conclusions: Good seed trees, but too large space to cover. Another tree should have been left in center. Ground conditions ideal for reseeding, but seed were not cast against prevailing winds, and trees were fully exposed to west wind. Barring unusually fortunate circumstances, center of triangle will not seed in until present seedlings commence to cast seed.

It is neither claimed nor expected that these comments bring out any new or startling facts bearing on the question treated. Therefore, their value, if any, may be mainly corroborative. The more so because the observations and investigations forming their basis were made entirely independent of and not influenced by the findings of any other investigator.

A STUDY OF WINDFALL IN THE ADIRONDACKS

By C. Edward Behre

INTRODUCTION

The country in the vicinity of Lake Ne-ha-sa-ne, N. Y., which lies about 60 miles north of Utica, on the Adirondack division of the New York Central Railroad, was visited during the month of May, 1916, by a windstorm which uprooted or broke about 5 per cent of the timber over a large area and did more damage than any other storm in recent years. About two weeks after the storm the members of the junior class of the Yale School of Forestry, who were at that time engaged in field work in the Adirondacks, made a study of the windfall.

HISTORY OF THE LOGGING

An unusually good opportunity was offered for a study of the effect of cuttings on windfall and to compare types and species as to susceptibility to windfall, because the history of the area in question was known and the area has been under management for several years. This tract, in fact, was one of the first in this country to be managed according to a working plan made by a technical forester. The original working plan was made and the first cutting supervised by H. S. Graves in 1896. The working plan called for a selection cutting. Spruce and pine over 10 inches in diameter on the stump were cut but practically no balsam and no hardwoods were taken. In these early cuttings two seed trees per acre which were 10 inches or more in diameter were left to secure reproduction. In the swamps, the cutting was in general heavier and fewer seed trees per acre were left than on the uplands.

On the area studied cuttings under this plan had been made in 1896 on the southeast side of the lake and in 1898 on the northwest side of the lake. These cuttings averaged about 2,600 board feet per acre. Graves estimated that between 2,500 and 3,000 board feet per acre were left in all types, which means that about 50 per cent of the stand was removed.

The tract is now under the management of F. A. Gaylord, who in 1915 started to cut over these areas for the second time. The portion

of the tract which had been logged in 1896 was cut again in 1915 while that logged in 1898 had not been cut since. The cutting as now carried on is much heavier than the original cut. The markets now permit the cutting of balsam as well as spruce and the presence of the railroad makes it possible to take out sound hardwood logs. The present cutting takes all spruce above 9 inches and balsam above 6 inches on an 18-inch stump and also any hardwood tree which contains not less than one 16-foot log, 12 inches d.i.b. at the small end. Trees above these minimum sizes, however, may be left as seed trees. The cut in 1915 removed from 75 per cent to 85 per cent of the volume. The following figures were compiled from two sample plots of six acres, each taken in the 1915 cutting. The 1896 cut was estimated from the stumps.

	Type	
	Balsam swamp	Hardwood
	Board feet	*Board feet*
Cut in 1896	3 200	2,400
Cut in 1915	7,900	3,800
Left in 1915	2,700	400

THE FOREST

The tract lies within the spruce region and the principal species are spruce and balsam among the conifers and yellow birch, hard maple, and beech among the hardwoods. The merchantable stands were divided for this study into three types, namely, spruce, hardwood, and balsam swamp.

Upland and bottomland stands containing over 60 per cent of spruce were classed as spruce type. The trees are tall, well formed, and close together and the best stands in the region are included in this type. It is the most valuable type in the region as it contains so much spruce. The soil on these areas is well drained and varies from quite deep to shallow and stony.

On the uplands the spruce type grades into the hardwood type when the spruce loses predominance. The hardwood type covers the rocky ridge tops and extends down the slopes to the spruce type. It is more open than the spruce type and contains many large-sized hardwoods and a few scattered pines. The percentage of spruce varies considerably, while balsam is much less in evidence. The soil is always well drained and often quite rocky.

The balsam swamp type includes swampy flats which are covered with dense and heavy stands of balsam and spruce with few hardwoods. The soil is moist to wet and comparatively deep.

The surface soil over the whole region is largely an accumulation of debris or humus with little mineral matter.

METHOD OF STUDY

In order to study the windfall a strip survey was made of an area located on either side of Lake Ne-ha-sa-ne in a belt from one-eighth to one-half mile wide extending for about five miles from below the outlet to above the head of the lake. Parallel lines were run by staff compass from the lake shore back into the country at half-mile intervals and a tally was made of all the trees in a strip one chain wide, tallying by types the number of trees of each species and diameter which were standing, uprooted and broken. The tallies were kept separate for the area logged in 1915 and that untouched since 1898. In this way a 2½ per cent estimate of an area of about 2,890 acres was made, of which 1,260 acres were in the area southeast of the lake logged in 1915 and 1,630 acres in the area northwest of the lake not recently logged.

The results of this estimate are summarized in the following tables:

SPRUCE TYPE.

Species	Area logged in 1898, 7.5 acres measured			Area logged in 1896 anad 1915, 5.9 acres measured		
	Total No. trees	Per cent standing	Per cent down	Total No. trees	Per cent standing	Per cent down
Spruce	1,085	98	2	526	96	4
Balsam	314	90	10	189	92	8
Hardwoods.	846	99½	½	130	99	1

HARDWOOD TYPE.

Species	Area logged in 1898, 28.1 acres beasured			Area logged in 1896 and 1915, 17.7 acres measured		
	Total No. trees	Per cent standing	Per cent down	Total No. trees	Per cent standing	Per cent down
Spruce	1,227	98	2	701	90	10
Balsam	153	86	14	210	79	21
Hardwoods.	2,817	100	0	1,730	99½	½

BALSAM SWAMP TYPE.

Species	Area logged in 1898, 5.1 acres measured			Area logged in 1896 and 1915, 7.9 acres measured		
	Total No. trees	Per cent standing	Per cent down	Total No. trees	Per cent standing	Per cent down
Spruce	270	98	2	192	93½	6½
Balsam	589	91	9	408	90	10
Hardwoods.	185	100	0	156	99½	½

CONCLUSIONS

From these figures it can be seen that the damage to any species was very uniform in all three types on the 1898 cutting. Thus in the 1898 cutting spruce showed 2 per cent and hardwoods practically none of the trees windthrown in all three types and balsam showed 10 per cent down in the spruce type, 14 per cent in the hardwood type and 9 per cent in the balsam swamp type.

In the 1915 cutting the damage to a given species was not quite so uniform in all the types. On the spruce type 96 per cent of the spruce was left standing and on the hardwood type only 90 per cent was left. That is, spruce showed a difference of 6 per cent in number of trees standing in different types. Hardwoods showed a similar difference of only one-half per cent, but balsam showed a range of 13 per cent between the spruce and hardwood types.

In general the damage was greater in the 1915 cutting than in the 1898 cutting. The damage done to hardwoods amounted to one-half per cent of the total number of hardwoods in the 1915 cutting and was negligible in the 1898 cutting. That is, the damage was only one-half per cent greater in the 1915 cutting than in the 1898 cutting, which indicates that, in so far as these species are concerned, heavy thinnings can be made with safety. With balsam the damage in the 1915 cutting was 2 per cent less in the spruce type, 1 per cent greater in the balsam swamp type, and 7 per cent greater in the hardwood type than in the same types in the 1898 cutting. Spruce showed similar differences in damage between the two cuttings of 2 per cent greater in the spruce type, 4.5 per cent in the balsam swamp type and 8 per cent in the hardwood type.

These figures show that on the lowlands the thinning had much less effect on the amount of windfall to conifers than in the hardwood type, where the thinning increased the amount of windfall 7 to 8 per

cent of the total number of trees. This difference is due to the fact that no hardwoods were cut in 1898 while in 1915 a very heavy cutting of hardwoods was made. Thus in the 1898 cutting the hardwood type was opened very little and the conifers were all well protected, while in the 1915 cutting the hardwood type was opened up excessively, much more so than the other types, and so the trees left were more liable to be thrown. Moreover, all the exposed situations are included in the hardwood type and the shallow rooted conifers are more susceptible to the opening up of the stand than the deeper rooted hardwoods.

In both cuttings and on all types balsam suffered the greatest amount of damage. This can be explained by the fact that balsam is the shallowest rooted of all the species and most subject to decay at an early age. Moreover, in the 1898 cutting old balsams which were found to be rotten at the base were left standing, while in 1915 the cutting of balsam was done strictly on a diameter limit. Thus the 1898 area contained an abnormally large proportion of rotten trees liable to be windthrown, while the 1915 area contained only the smaller more windfirm trees.

Of the few hardwoods damaged the greater number appear to be broken rather than uprooted, but there seems to be correlation between age and breaking or uprooting.

The damage to balsam was about equally divided between uprooting and breaking. Breakage was more common than uprooting in the case of the larger trees, probably because such a large percentage of the older balsams were rotten, and uprooting was more common in the case of the smaller and hence younger trees which were still sound.

The spruce was uprooted much more often than broken and this was especially evident in the 1915 cutting, so that the thinning seems to have increased the damage by increasing the proportion of uprooting to breaking.

In all cases the damage was greater to the trees of large size than to those of small size in proportion to the number of trees of the different sizes.

With both spruce and balsam the site appeared to have an influence over the nature and the amount of the damage. As stated above these species were damaged most severely on the sites in the hardwood type where the exposure was greatest. On the more protected upland sites, however, where the individual trees would tend to develop a deeper and more spreading root system, the damage was not so great

as on the wet lowland sites where the trees would develop shallower root systems. Moreover, there seemed to be a larger proportion of trees broken on the drier sites while on the wetter sites the greater proportion seemed to have been uprooted.

As the hardwoods are confined to the well-drained sites and because so few of them were thrown by the wind, the effect of site on the damage could hardly be determined but it appeared that the damage was quite uniform on all sites.

SUMMARY

From this study it is evident that a thinning of the character being made on this tract and briefly described above does not materially increase the liability to windfall. Under ordinary conditions only slight damage will result and when an unusually heavy wind storm occurs the damage is shown to be practically as much in unthinned stands as in those recently thinned. Where a very heavy opening is made in the stand, however, as shown in the case of the hardwood type, the damage will be increased to a much greater extent. Such openings either should be avoided or else the adjacent softwoods should be cut much more heavily.

SOME PHASES IN THE FORMATION OF FIRE SCARS

By H. G. Lachmund

Forest fires in the coniferous forests in California have in the past been typical ground fires. As a result of their constant recurrence open fire scars are abundant. Commonly these scars, when examined closely, will be found to have been hollowed out by successive fires. In the course of time a number of these lesions heal over and become enclosed. In addition, another type of injury representing the first stages in the process of fire scar formation is common on areas recently swept by fire. Where fire at the base of a tree is sustained long enough by accumulated litter or resin exudations the heat becomes sufficiently intense to kill living tissues without actually burning away the bark, which at first remains closely attached to the sapwood. But in the healing process calluses form beneath the bark around the edges of the killed area and, gradually growing in from all sides, force the old bark away from the dead sapwood. The bulging growth of the calluses and drying out cause the bark to crack and split, following which it commences to drop away in pieces until finally the sapwood is exposed.

The period of time required until the wood becomes exposed varies according to the rate of growth of the tree, the form of the calluses, and the size of the wound. Even in fast-growing trees observations have shown that five to ten years may elapse before the old bark covering the wound peels off, while in slow-growing trees it may take a considerably longer time. Due to their inconspicuous character during the years immediately following the fire these wounds are generally overlooked though they may constitute a considerable proportion of the fire damage to the stand.

As a direct cause of loss in merchantable volume they are negligible, but in providing a mode of entrance to infection they may be of considerable importance. As long as the old bark adheres to the injured portion it affords more or less protection. When it drops off and leaves an open wound destructive fungi find an easy access to the wood. For this reason care should be taken, in accurate appraisal of fire damage to stands recently swept by ground fires, to search for these fire injuries, particularly if the stand is largely composed of

species subject to serious loss from heartrots. Close examination where thin bark is charred will often show the bark to be split vertically in places, disclosing dead sapwood. Tapping on the bark will sometimes indicate that it is loose. Again it may be ridged and cracked over the calluses or sunken over the center of the wound. In other cases it is only by chopping through the bark that the existence of the hidden wound may be ascertained.

Once the cambium and sapwood are exposed conditions are favorable for the actual burning out of the wood in the next fire. This might especially be expected in the pines and in Douglas fir where the wound surface generally is more or less covered by a film of resin. This film, however, appears not to be essential for the production of large or deep fire scars, to judge from the following data collected on California timber sales during cull studies carried on under the direction of Dr. E. P. Meinecke, Office of Forest Pathology. The data cover all trees of merchantable size, with the exception of sugar pine and seed trees, on portion of six Forest Service timber sales in California. The data on sugar pine being too scanty for consideration are disregarded. The areas studied are fairly representative with regard to fire injury for the bulk of the mixed coniferous forests of the Sierra Nevada. Only open fire scars are here considered.

Number of trees:

Incense cedar, 702; yellow pine, 1,271; white fir, 359; Douglas fir, 425.

Per cents of trees showing open fire scars of all types:

Incense cedar, 61.5; yellow pine, 12.7; white fir, 25.0; Douglas fir, 17.2.

Per cents of the above fire-scarred trees with large or deep fire scars:

Incense cedar, 58.1; yellow pine, 44.2; Douglas fir, 39.8; white fir, 32.2.

Of all four species incense cedar is by far the most susceptible to fire injury and in more than half of the cases the fire eats deeply into the tree. In yellow pine not only is a smaller per cent of trees scarred than in incense cedar, but the percentage of deep burns also falls off. Both Douglas fir and white fir resist initial fire action to a far higher degree than either incense cedar or yellow pine, but a different relation obtains between the species as to the occurrence of heavier burns. Douglas fir stands lowest in percentage of trees scarred but approaches

the percentage for heavy burns in yellow pine. In white fir relatively few trees show signs of fire, and of these only 32 per cent or about one-third are badly scarred.

Among the factors having an influence in the initial wounding by fire may be resin content, structure and relative thickness of the bark. The bark of incense cedar is resinous, and is fibrous in structure. That of yellow pine is resinous and, though flaky on the outside, is more solid than that of incense cedar. Both white fir and Douglas fir have compact corky barks which are relatively poor in resin content.

Considering heavy burns alone incense cedar still heads the list. Then follow yellow pine and Douglas fir, and lastly white fir. It is a common belief that the resin content of the wood favors the formation of large burns. Yellow pine and Douglas fir have resinous wood. In both incense cedar and white fir, standing at the head and the end of the list, the bark only contains resin while the wood is non-resinous. The scattered resin cells in incense cedar wood are too insignificant to influence the burning properties of the wood as compared with the richer resin content of yellow pine and Douglas fir wood.

That these open burns play an exceedingly important rôle as starting points for serious decay in coniferous trees is well known. Meinecke's [1] data on decay in relation to wounds in white fir show that in over 40 per cent of the cull cases the decay is traced exclusively to fire scars while Boyce,[2] working on incense cedar, finds that 84 per cent of the severe cull cases develop from decay entering through fire scars. The prevalence of decay in white fir and incense cedar which largely contributes to the decided prejudice of the lumberman against these species is thus in a large measure chargeable to fire.

According to the data given and contrary to the general impression the resin content of the wood itself does not play a leading rôle in the burning of more severe fire scars. Resin in the bark undoubtedly adds materially to the inflammability of the outer parts of the tree and thereby becomes an important factor in the killing of the cambium by fire. When the flames, after destruction of the bark, begin to eat into the wood other factors than mere resin content govern the combustibility of the latter and contribute to the enlargement of the original injury to the serious burns so common in coniferous forests of the West.

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[1] Meinecke, E. P.: Forest Pathology in Forest Regulation. Bull. No. 275, U. S. D. A. 1916. Pp. 51-52.

[2] Boyce, J. S.: The Dry-rot of Incense Cedar. Bull. No. 871, U. S. D. A. 1920. P. 45.

COOPERATION IN FOREST PROTECTION [1]

By R. S. Kellogg

Chairman of National Forestry Program Committee

The discussions of the past 30 years received added impetus when Forester Graves in 1919 inaugurated a series of country-wide conferences on the subjects of forest protection and reproduction.

The first clear-cut and complete forestry program announced by a trade organization was that of American Paper and Pulp Association November 11, 1919, which declared that any proposed solution of the problem of a permanent timber supply must be:

(1) Adequate and practicable to produce the needed results,

(2) Just to all interests concerned,

(3) Acceptable to the majority,

and made definite suggestions for legislation to accomplish these purposes.

This was followed by a second report of the American Paper and Pulp Association on April 15, 1920, and a similar report was made about the same time by the Western Forestry and Conservation Association.

Interest by practical men and business organizations rapidly grew and on October 15, 1920, there was held a conference which resulted in the formulation of the Snell bill and the organization of the National Forestry Program Committee.

The underlying principle of the Snell bill is to secure continuous forest production upon all land chiefly valuable therefor through Federal leadership and cooperation with the States and timberland owners—the same principle that has been applied for 60 years in the development of the agricultural resources of the United States, and more recently in the good roads program, vocational education and many other projects of great importance. It is tried, tested, and practicable.

Since the announcement of the National Forestry Program, either its basic principle of Federal leadership and cooperation or the com-

[1] Abstract of statement submitted to the Forestry Committee of the Chamber of Commerce of the United States, June 27, 1921.

plete Snell bill has been endorsed by over 100 State Foresters, State Forestry Associations, Chambers of Commerce, trade organizations, etc. The bill has also been introduced in the Senate by Senator McCormick.

PROPOSED NATIONAL LEGISLATION

The National Forestry Program is a complete one touching all phases which are properly the subject of Federal legislation and setting up adequate machinery for cooperative solution of the problem.

The main features of the program as embodied in proposed Congressional enactment provide for cooperation between the Federal government, the States, and owners of timberlands for adequate protection against forest fires, for reforestation of denuded lands, for obtaining essential information in regard to timber growth and utilization, and for the extension and blocking up of National Forests into better forest and administrative units.

The provisions of the Snell and McCormick bills to accomplish these purposes are briefly as follows:

Section one directs the Secretary of Agriculture, through the Forest Service, to recommend for each forest region, the essential requirements for protection against fire, proper methods of cutting, reforesting of denuded lands, and to cooperate with the States and other agencies for the effecting of methods to furnish a continuous supply of timber for the people of the United States.

Section two authorizes the Secretary of Agriculture to withhold Federal aid from the States which do not cooperate with the Federal government, and provides that the Federal expenditures within a State shall not exceed the expenditures by the States and by forest owners required by State law in any fiscal year.

Section three provides for a national survey of forest resources and requirements for timber and a classification of land chiefly suitable for timber growth.

Section four provides for extensive investigation of forest growth and utilization and scientific studies of the properties of timber and market conditions. A study to determine methods of equitably taxing forest lands so that they may be held for future growth is also directed.

Section five provides for the establishment and maintenance of forest nurseries, and the sowing of seed and planting of trees in the National Forests.

Sections six and seven provide for the purchase of lands to be added to the National Forests as recommended by the National Forest Reservation Commission.

The final sections provide for blocking out true forest areas by exchanging Government land or timber for forest land now privately held within or adjacent to present National Forest boundaries. The addition of Government land now within the Forests to the National Forests when most suitable for forest production, is provided, and methods of accomplishing these reclassifications of Government lands are specified.

This program provides for:

(1) Protection of the present supply of timber.

(2) Scientific utilization of it.

(3) The production of a future supply.

The introduction of these bills marks the first attempt ever made to secure passage by Congress of a complete measure covering all phases of an adequate National Forest Policy, but on the other hand it involves no new or revolutionary ideas or procedure. It simply means putting together and setting up for the first time a permanent policy on the part of the National Government in the dealing with all phases of the question of continuous timber production upon all forest land in the country whether in public or private ownership.

The basic principle is that of Federal leadership and assistance in cooperation with State and private agencies. The plan is workable, effective along trails already blazed, and one that involves the minimum expenditure of Federal funds and the minimum number of Federal employees—which is greatly to be desired at this time when economy in public administration is imperative.

The problem before the country is to secure the permanent production of more timber. This can never be accomplished through direct compulsion from Washington upon the private owners of timberland. Congressional enactment can force the growing of timber only upon land in Federal ownership. The States, through the exercise of the police power which they possess and which the National Government does not possess, can and should make drastic regulations to prevent forest fires and they can and should tax forest land equitably and not inequitably. The problem will not be solved until conditions are such that the investment of private capital in timber growing and holding of land for forest crops is a safe and profitable undertaking.

History abounds in reports of legal attempts to compel things which a large majority of the people were opposed to and to force capital—which is the people's savings—into unprofitable channels, but history

has not yet recorded a single instance in which economic injustice has produced prosperity for any country as a whole or which has increased the supply of necessary goods and materials.

One of the most recent instances of this sort is the housing situation in New York City. Everyone is familiar—and many painfully familiar—with the increases in rents which occurred last year and the general cry for more building of places in which people might live. New York City secured a special session of the State Legislature and the enactment of drastic laws, which were designed to prevent the owners of rented buildings from getting what was deemed to be more than a fair profit upon their investment. The bills were passed by the Legislature almost immediately upon presentation, signed in still less time by the Governor, and everybody went home with the general claim by the newspapers that the situation had been relieved. Some people were undoubtedly protected from having their rents raised exorbitantly, but the main problem was to have more apartments and houses built in which people could live. The result was that during the month of January, 1921, not a single permit was issued for the construction of an apartment building on Manhattan Island, and rents in such buildings continued as high or even higher than before, while at the same time a large number of modern office buildings were going up and office rents coming down precipitately. In other words, the investor refused to put his money into apartment buildings and did put it into office buildings. A recent act exempting lower-cost dwellings from taxation for a period of years has greatly stimulated building.

The same course of reasoning applies to the forestry problem in the United States. Were there a timber monopoly, as some insist, the only successful antidote for it is the creation of conditions under which more people will begin the growing of different kinds of timber throughout the country. It is the creation of these conditions that the National Forestry Program Committee seeks and this is what I mean when I say that the principle of Federal leadership and assistance with State and private cooperation is a workable and effective solution of a problem that must be solved, if the basic industries of this country are to have an adequate supply of raw material.

This program is opposed by a few radical foresters who say that it will be ineffective because it lacks compulsion—an opinion incapable of proof—and by many lumbermen who declare that it is a step in the direction of invasion of vested rights.

It is supported by a large majority of the foresters and National and State authorities who will be responsible for its execution, by many owners whose operations will be affected, and by nation-wide public opinion of the most intelligent sort.

STATE FOREST POLICIES

In order to fix the responsibility which lies with the States and private owners of timberlands under the National Forestry Program which has been set up, it is further suggested that any effective State forest policy should be based upon the following principles:

(1) That all soil shall be made productive of the crop to which it is best adapted or for which there is the greatest public need.

(2) That while agriculture and forestry are based upon soil production, the methods necessary in forestry and the time involved are so different from those of agriculture that forestry demands an entirely different form of administration.

(3) That State forest policies shall be initiated and carried out in cooperation with the National Government and with private owners wherever and to the fullest extent possible.

(4) That State forest legislation shall establish general principles and procedure only and vest in a properly constituted and non-political body, acting through technically qualified representatives, the responsibility for the fixing of regulations and enforcing them.

(5) That the paramount and immediate consideration in any forest policy is the creation and maintenance of effective means for the prevention and control of fire on all forest lands of whatever ownership, and that every owner of forest land shall be required to conduct operations thereon in such a manner as to avoid creating a fire menace to adjacent property.

(6) That forest surveys, land classification, forest research, and forest education shall be provided for.

(7) That there shall be such changes and adjustments in prevailing systems of taxation as will enable all forest lands to be equitably taxed thereunder, yet will not discourage the holding of private forest land for future crops without impairing local revenues.

(8) That the State, upon request, shall assist the private owner of forest lands to make them continuously productive through the preparation of working plans, supplying of planting materials and supervision of silvicultural operations free of charge or at cost.

(9) That the State be empowered to take over at a fair valuation and administer as part of the system of public forests any land which, after competent examination, is classified as suitable only for timber growth, in case the owner refuses to avail himself of the opportunities

and assistance provided by the public to encourage forestry upon private lands.

(10) That the acquisition of forest land by the State is essential to a sound forest policy.

(11) That all State-owned forests shall be utilized for continuous production, both for direct returns in forest products and indirect returns in soil protection, game, and recreation.

(12) That all State-owned forest property shall be capitalized upon the records of the administrative body so that all expenses in connection with the development thereof and returns therefrom may be accounted for on a business basis to the people of the State who furnish the funds for the undertaking and enjoy its results.

The fundamental problem is to grow more trees. This will not be accomplished by legal compulsion upon the private owner. It may be accomplished through leadership, cooperation, and the adoption of measures that will make it safe and profitable for private capital to seek permanent investment in forest production.

RECLAMATION OF GRASS LANDS BY UTAH JUNIPER ON THE TUSAYAN NATIONAL FOREST, ARIZONA

By Fred H. Miller

Forest Ranger, U. S. Forest Service

One of the most striking features of the landscape along the Ocean-to-Ocean Highway between Ash Fork and Williams, or on the Phoenix Branch of the Santa Fe Railroad from Ash Fork to Cedar Glade, is the large number of young juniper trees which are growing in open parks or prairie lands. In a number of places reproduction is seen growing at distances of from one to two miles from the nearest seed trees.

An investigation of this phenomenon was conducted along with the field work done in connection with the preparation of a plan of management for the woodland areas of the Tusayan National Forest. Two large open areas were studied.

Wagon Tire Flat, located east of Cedar Glade, is the largest area and most typical example of the encroachment of tree growth on grass lands. As the name implies this area is a large, comparatively level tract approximately 7,485 acres in extent. The soil is moderately deep, formed chiefly from the disintegration of malpais or lava. Many small rocks from two to six inches in diameter are scattered throughout the soil. The texture varies from a stony clay to a very stony clay. Because of the presence of rock, this area is practically worthless for agricultural purposes. However, since the annual rainfall in the vicinity of Cedar Glade averages only 15 inches per year, successful farming is out of the question for this climatic reason alone. Nevertheless, the locality is ideal forest land. The site is of the best quality for the Utah juniper type.

Tobosa grass (*Pleuraphis mutica*) is the principal forage plant growing upon Wagon Tire Flat. This grass does not form a dense sod, neither is it consumed to any extent by grazing animals; accordingly, it is not close cropped as are some of the better forage plants, grama grass for example.

Because of the fact that tobosa grass does not form a dense sod, much mineral soil is exposed. The presence of the numerous small

rocks in the soil prevent it from packing. The heaving action of frost on the soil loosens the surface, often causing it to break into numerous small cracks or fissures. If any juniper seed is deposited on this area the chances of its germination and the establishment of the seedling are exceptionally good.

Page Flat is another large open area lying south of Cedar Glade. Approximately 1,920 acres of this flat lie within the National Forest boundary. The soil on Page Flat is of different composition from that on Wagon Tire Flat. The soil is likewise moderately deep, but is composed of disintegrated lime and sand stone, and malpais in about equal proportions. It is a fine, compact, gravelly silt loam.

The area is now overgrazed and sustains a number of species of weed plants. Originally this flat carried a grama grass sod.

STOCKING OF THE AREAS

Forty-two sample acres, distributed on every section within Wagon Tire Flat, when compiled gave the following stocking per average acre:

Height	No. of trees	Av. per acre	Percentage
0–5 ft.	2,130	50	83.3
5–10 ft.	409	10	16.7
Total	2,539	60	100.0

Sixteen sample acres distributed over every section on Page Flat (within the forest), gave the following per average acre:

Height	No. of trees	Av. per acre	Percentage
0–5 ft.	298	18	78.3
5–10 ft.	76	5	21.7
Total	374	23	100.0

SEEDLING GROWTH

A seedling study was undertaken in order to get an idea of the age of the young trees growing on the open areas:

Table 1.—*Utah Juniper. Open Grown. Utah Type. Site Quality I. Tusayan National Forest.*

Age	Av. diam. from field data	Curved diameter, inches	Av. height from field data	Curved height, feet	No. of trees
1	....	0.05	....	0.1	0
2	....	0.05	....	0.4	0
3	....	0.15	....	0.6	0
4	....	0.20	....	1.0	0
5	0.3	0.30	1.2	1.3	1
6	0.4	0.40	1.4	1.7	3
7	0.0	0.60	2.2	2.1	6
8	0.9	0.80	3.3	2.6	3
9	1.0	0.95	3.3	3.1	7
10	1.1	1.15	3.8	3.6	2
11	1.4	1.30	4.2	4.1	3
12	1.7	1.50	4.4	4.5	3
13	1.65	1.75	4.4	5.0	2
14	1.9	2.00	4.7	5.4	3
15	2.5	2.30	6.4	5.8	2
16	....	2.60	....	6.3	0
17	3.2	2.90	7.0	6.7	2
18	3.1	3.15	6.5	7.1	1
19	4.0	3.45	10.0	7.5	1
20	....	3.70	....	8.0	0
21	3.0	4.00	7.6	8.4	1
Total....	....	....	....	....	..40

The data given above show that 80 per cent of the stocking of the open areas has come in within the past 13 years. The average age of the remaining 20 per cent does not exceed 25 years.

DISTRIBUTION OF SEED

The seedlings growing upon the grass land areas are almost exclusively *J. utahensis*. Very rarely are any small *J. monosperma* found. In the mature stands of timber in the vicinity *J. monosperma* is very scattering and composes less than 1 per cent of the stand.

The fruit of *J. utahensis* is large, the flesh edible and of a dry, mealy texture. The berry shrinks in size but little after ripening and falling to the ground. On the other hand, the fruit of *J. monosperma* is small and the flesh is juicy. After ripening and falling the berry shrinks until it becomes so small that a grazing animal would have difficulty in picking up the fruit. However, the fruit of *J. monosperma* is eaten in large quantities by birds. Accordingly, the seedlings of

the latter species are found almost exclusively under the crowns of either the mother or nurse trees of other species.

Many seedlings and trees of varying ages are found along stream courses within Wagon Tire Flat. This distribution is obviously caused by flood waters. In such places Utah juniper is always found growing at greater distances from the seed trees than are seedlings of one-seed juniper. This fact is undoubtedly due to the comparatively lighter and more bulky Utahensis seed.

The presence of seedlings on every acre of Wagon Tire Flat cannot be explained by distribution of seed by water, for the greater part of the area, although generally level, is never reached by flood waters. Cattlemen in the vicinity stated that sheep eat the juniper berries, and the seeds are scattered by passing through these animals. Seed dissemination, however, has taken place within the past 25 years or since the time domestic stock has used the range.

Some time was spent in watching sheep grazing in the woodland forest to see if they could be detected in the act of eating juniper berries, but no proof was obtained. However, there was plenty of good forage available at the time and place the observations were made.

For some time no evidences were found that seed actually passed through the sheep, until one day a Utah juniper seedling was noticed growing through sheep manure. Further examination showed that the seed coat was still enclosed within the dried manure. There was no doubt as to the manner in which this seed had reached the place of germination. The area surrounding this seedling had been used as a bedding ground in the fall of 1919. Within a radius of five feet around the original seedling, three other seedlings were found in the same stage of development and eleven ungerminated seed still enclosed within the dried manure. After the original discovery many more seed were found under similar conditions, sometimes at distances exceeding a mile from the nearest mature trees.

Evidently coyotes and other native animals also eat juniper berries, for their manure is frequently found containing many seed.

CONCLUSIONS

Dissemination of Utah juniper seed on open areas is caused chiefly by sheep.

On the Verde-Ash Fork Working Circle of the Tusayan National Forest from 10,000 to 15,000 acres of grass land have been reforested through the agency of sheep.

The seed of *J. monosperma* is not eaten in such large quantities by sheep as are the seed of *J. utahensis*, chiefly because of the size of the fruit of the former species.

Parklike areas having a dense compact soil and covered by a grama grass sod are always deficient in juniper reproduction.

Similar areas having a loose, rocky soil and covered with a tobosa grass type of forage are always well stocked with reproduction.

On the latter sites, mineral soil is exposed; hence, good conditions for germination are encountered. Grazing animals do not crop tobosa grass close to the ground, thereby giving the small seedling a good chance to escape being eaten.

On the former sites, seed bed conditions are not so good. Grama grass is very closely eaten by animals, and there is accordingly a possibility of the small trees being taken up by the animal with a mouthful of grass.

FOREST TAXATION [1]

By W. G. Hastings

Forester, State of Vermont

A recent report by the United States Forest Service [2] shows the following timber situation: Only one-third of the original stand and two-thirds of the original acreage of timber in the United States still remain; in 60 years the lumber industry has moved into and exhausted successively four of the five largest timber regions of the nation; most of the virgin timber left standing is situated 2,000 miles west of the center of population, and a six-to-one relationship exists between consumption and production of saw timber. The facts about timberland exhaustion enumerated in the above referenced report are more startling and point more clearly to a downward trend in timber supplies in the nation than any other reported facts that have been assembled. Although it has been known for half a century that timber exhaustion was inevitable and although efforts to postpone the resultant famine have been sustained and serious, destruction has actually gained apace—it matters not from what angle the subject may be viewed.

For an average period of 20 years the Nation and half of the States have appropriated money for the maintenance of forestry departments, hoping thereby to create static conditions in timber consumption and production, but the task has proved greater than their powers to achieve, and will remain insurmountable in spite of ever increasing expenditure of public money so long as we attempt to correct the evils of denudation through appropriations and fail to remove the cause which lies back of the condition, whatever the cause may be. You cannot permanently aid a famine-stricken country by continuing ". . . to pour a pitiful stream of rice porridge down the bottomless throat of famine." Rather, the occasion for it must be removed. And so it is with denudation—the cause must be discovered and destroyed. In nature the forces of production and destruction are equal

[1] Abstract of a paper read before the convention of Northeastern Tax Commissioners, Burlington, Vermont, Dec. 12, 1920.

[2] Issued June 1, 1920, in response to Senate Resolution 311.

and it requires but little action from man upon either side of the balance to put either set of forces in the ascendency, and since man's action is usually a response to his desire for pleasure or power or profit, it is evident that the destruction of the forests of the Nation holds at least one of these three rewards for him. One of the causes of denudation lies in the fact that it is still more profitable to destroy than to produce, and the greatest single item of expense in the production of timber is taxation. However, the unjust balance existing between costs of timber production and sale values of stumpage is not the only cause of denudation. There are other causes—too intangible, perhaps, and possibly too sacred, to permit of analysis or modification. These may be defined as "democracy" with which we should be forbidden to tinker even for the purpose of removing one of the causes of non-productivity of timberland. It seems, therefore, that taxation plus a mistaken *tenure policy* are the causes of denudation; and the remedy will be time-consuming and costly.

No real endeavor has been put forth to correct the land tenure policy of this nation, and perhaps no effort should be made to do so. On the other hand, every mother's son since Adam has taken a fling at taxation. The trouble in all previous attempts at timberland tax reform may lie in the fact that at least one fundamental truth has been overlooked, namely: *Forest soils possess a value based on the power of the soil to produce, and this value is the sole taxable entity of the growing forest.* To some people this may be a debatable question, and therefore the affirmative of the proposition may be developed somewhat as follows:

As a starting point certain fundamentals need to be reviewed. In a nutshell these are the forest itself and forestry, and the tenets of taxation. The forest is composed of two parts—the stand and that upon which it stands. In other words, in reverse order, it comprises an area of land surface, as one component part, and the timber which it supports as the other part. These are *separate entities* foolishly bound together in the public mind. Forestry, on the other hand, is a public policy so far as the taxing authorities are concerned and every system of taxation devised for timberlands should take into consideration this dual meaning of the word "forest" and the factors recently brought to light by the United States Forest Service and enumerated at the beginning of this paper which have made necessary the forma-

tion of a forest policy. Also it is a truism that taxes are levied and collected to meet public expense for the public good and are not levied, or should not be, for the purpose of stifling or fostering trade. The assessment of value should not be full, the rate should be uniform and the tax should be collected yearly. Through the operation of simple, workable machinery it should be collected once and only once, and in a manner to cause as little friction as possible. And above all things else, taxation for revenue purposes should be based on the ability of the individual to pay because he possesses that particular piece of property. Upon these fundamentals there is perfect accord, and when we consider with them the injustice in the systems of timberland taxation now in existence, if measured by these fundamental truths, the axiom pronounced above to the effect that site taxation is possible and desirable, stands out clearly as a solution to a perplexing problem.

An analysis of these systems that failed will testify to the need for a change and will tend to show the need for an entirely new basis for forest taxation, namely, ability of the soil to produce.

The application of the so-called property tax system of taxation to a timber tract creates an intolerable financial condition which has been a burning question with American foresters and lumbermen for decades. For example: the sum of a series of variable payments made yearly for a period of 50 years (taxes) based on an ever increasing valuation identical with cost (starting with an initial valuation of $12 per acre for land and planted young timber) amounts to $268.21 when the tax rate is 300 cents on the grand list (30 mill tax) and when 4 per cent compound interest is reckoned on all taxes paid from the date of payment to the end of the 50-year rotation. This $268.21 represents the tax burden for a single acre. It is the tax money paid out in 50 years and its accumulated interest. It includes neither the investment fund nor interest upon it, nor profits of any kind. To increase the 50-year rotation even slightly means a tremendous increase in the tax burden. And since, under present conditions, the soil cannot be induced to grow $268.21 worth of timber in 50 years there is no disputing the fact that such a system is confiscatory; therefore, another system of taxation must be devised and employed.

The injustice of the property tax when applied to stands of growing timber was early recognized and decried by foresters, and years ago,

as well as more recently, attempts were made by them and timberland owners to correct the evils of the system by passing legislation postponing the date of payment of taxes. These early attempts were based on the fallacy that a harvest tax which took a part of the final yield in lieu of a regular tax against the soil was just in theory and easy of application. Much has been written on the subject of forest taxation from the standpoint of the harvest tax, and much of that which has been written must be discounted, for, in many cases, at least, a special interest of some sort was the urge which fathered the thought. Or, lacking that interest, the author's judgment was biased by the mass of literature emanating from such sources. Under the influence of one line of reasoning or another measures religiously dedicated to the theory of the harvest tax have been enacted, and just as religiously these laws have failed to accomplish their purpose. Connecticut, Massachusetts, and Vermont have had such laws on their statute books for a period of time sufficiently long to prove that these laws are not popular, and to strengthen the conviction long held in my mind that the harvest tax is wrong in theory. Also, there are others among us who, upon sober second thought, have come to doubt that the harvest tax theory of taxtion is correct. Stated simply, and with no attempt at a full analysis, the harvest tax theory is wrong because it assumes that the owner of *land* is bearing his just share of government if he divides his income with the State, be his income large or small. If the final crop is poor, the tax is small; if it is heavy, the tax is large. Therefore, the system penalizes thrift and good husbandry and rewards sloth. In my judgment it is unfair and unjust to both the land owner and to the State, for the crop produced is no criterion of the owner's ability to pay. The system violates nearly every tenet of taxation and its failure was therefore inevitable.

Perhaps the framers of the measures which have been tried and failed saw the difficulties and shortcomings in the harvest tax theory and attempted to correct the evils by levying a *small* harvest tax in order that the wrongs might be mitigated, and also a small yearly soil tax as well, to even matters up a bit. This soil tax was a flat tax of a few cents per acre per year based on a fixed assessed value of say $2.50 per acre. But here again the system fell down because it failed to measure up to the ability-to-pay axiom. The system is wrong because it is based on the assumption that there will be a steady

increase in values. It assumes that the yearly tax collected from an assessment of $2.50 per acre does not levy all the tax the property should pay. The assumption is pure guess work. There is no science in it. Some soils of low producing power and inaccessibly situated cannot stand such a tax, while other soils can pay infinitely more. For example, take Vermont's "wild-land" law, which permits of the classification of timberlands and provides for no increase in assessed value until 1950, and which provides for a harvest tax when the timber is cut. Take also the lands of a well-known timber-holding company whose average quality cut-over lands are now assessed at $6.35 per acre. The tax on this flat appraisal alone, were such lands classified (some of them are), would amount in 70 years, based on present-day stumpage, to a sum greater than the value of the timber crop to be grown! And yet the harvest tax theory assumes that something has been held back in the form of taxes, and that a considerable fractional part of the stumpage value must be surrendered! Half a dozen States have tried to correct the evils of the property tax system of taxation in some such manner and the attempt has failed, for such laws are fallacious, inquisitive, provocative, and require special tax machinery to execute their provisions. Therefore, it is time to quit dodging the issue and to undertake tax reform in a manner and on a basis which squares with the tenets of taxation and with all other known requirements of a good law.

This can be done. To do so, keep in mind the fundamentals enumerated above, as well as the proposed soil productivity axiom, and a way out of the dilemma in which forest taxation finds itself can be found through two property taxes, one assessed against the land on a soil productivity appraisal and the other against mature timber on a sale value appraisal. So simple a system sounds too good to be true. But it is true to the core, and withstands every test. Of the two property taxes levied, the first—a land tax—is the principal tax when the owner is guarding the public interest to the extent and in the manner the public has a right to demand. When he is not so guarding the public interest he is either holding land in a non-productive condition to his own detriment or he is holding back from the market certain stands of timber ready to be cut, in which case the second property tax also will be levied, namely, a property tax against mature timber.

Let these property taxes, a land tax and a mature timber tax, be outlined individually in the reverse order.

The tax against mature timber is justified on the ground that timber is being taxed at present; that its period of development is past; that it is physical, tangible property and represents wealth. Also, in most cases, it represents a speculative venture and as such is producing wealth. The owner is holding it just as a broker in the wheat pit holds wheat—with the hope, and usually the certainty, of realizing greater profits from increased stumpage in a rising market than by operating the tract and turning his money to some other account. It is considered correct in theory to tax mature timber because it has reached a stage in its development when, unlike a growing crop, it has a commercial use value. The *assessed* value in this case should be the *sale* value of the property.[3] The tax against the land alone is also justifiable. The land, like mature timber, is physical, tangible property and its possession represents wealth. But here the simile ends. The mature timber is held for the rise in market values, or as a storehouse for raw material to be manufactured by a plant now in existence, while the land is held because it possesses a *power* to produce additional property.

All lands possess this power to a greater or lesser degree. Some have more of it than others, and therefore are more valuable, other things being equal, than less gifted lands. *And in this we find the solution of the problem.* The land alone, which is, or is to be, devoted to the production of timber has a measureable power to produce timber, and since timber has a sale value, this power to produce possessed by the soil has a value also, which the forester calls the expectation value of the soil. The determination of such value is simple and in its minutest detail of application foresters find it unnecessary to distinguish more than five classes of soil as far as site qualities are concerned. Now, if the foresters of Baden, Saxony, Bavaria, and other German States find that five classes of soil fit conditions in Europe there is no reason why five, or even three, classes of soil, as far as timber producing power is concerned, will not fit conditions of one State here. But no matter if there were an infinite number of classes of soil, distinguishable, as far as the power to produce is concerned, between sites ill adapted to tree growth, and sites best suited for that purpose, soil expectation values occupy comparatively a narrow range

[3] It is realized that forest economists of the Pacific Northwest might justly find fault in these conclusions; however, there is a similar solution to their problem.

of figures, is the point emphasized. *And this Se value for a given quality of soil, or some fractional part of it, should be the assessed value of the soil.*

A forest property can stand it to be taxed on such a valuation and no more. If this value of the soil be taken as the assessed value, then no righteous assessment may be placed against the growing crop. If we should tax the natural power of the soil to *produce*, that is all we would have any right to tax until the thing we are producing is produced; namely, a mature crop of timber. In justice a growing crop of timber is not taxable property. To tax it every year for 100 years at its sale value (and it has a sale value—and expectation value—though it has no use value) is as wrong as it would be to tax a crop of potatoes at its sale value every morning for one hundred days. Neither crop can stand it to be taxed that way. The final yield will not pay the tax bill. Farm land is assessed according to its power to produce and the crops justly escape taxation. They are not exempt from taxation. They are simply *not taxed*. It is too obvious to the listers that farm crops are not taxable when a tax on farm land is collected based on the power of the soil to produce. The same principle applies with equal forces in forest taxation, for here also the soil has a power to produce. In both cases this power possessed by the soil should be reduced to a base value and the tax assessed against it. In the case of the farm this is actually what happens, for the farm's power to produce and its sale value are closely associated in the minds of men. This is not so in the case of the forest, however, for here the sale value of the soil often shows no relation to its productivity value. And yet, the real taxable entity—power produce—should be deduced and taxed.

The application of this principle is not difficult. The soil expectation values should be determined by a competent authority for the best and the poorest sites which a prudent man may be expected to use for timber production purposes. Maximum and minimum values would thus be established as guides for the listers in fixing all assessment values between these extremes. These upper and lower limits of value should be written into the law and should be placed as close together as the computing authority can in justice persuade himself to do, and the whole scale of values should be kept as low as reason will permit. In determining these upper and lower limits of value

the computing authority would undoubtedly recommend figures to the legislative body differing from those derived from exact mathematical calculations[4] by an amount justifiable by the deplorable state much of our timber is in at present. From only a small portion of this land can we expect a normal yield during the first rotation. The get-away has been too poor. The handicap of a poor start (wrong species, insufficient stocking, faulty distribution of age classes, etc.), cannot be overcome in one or two decades. Therefore, in placing the first set of limits to expectation values as guides for the listers in fixing assessed values the hard facts must be tempered by justice to all concerned.

The following suggested measures are included to show how simply this principle may be embodied in a law:

AN ACT TO PROVIDE UNIFORMITY IN METHODS OF FOREST TAXATION AND TO RAISE REVENUE FROM FOREST LANDS PROPORTIONATE TO THEIR ABILITY TO CONTRIBUTE TOWARD PUBLIC EXPENSE.

SECTION 1.—Lands lying outside the limits of a city or village, which the listers at a quadrennial appraisal determine and decide are used for no more remunerative purposes than for timber production, shall be set in the list as wild lands, and shall be appraised quadrennially without regard to either the live trees thereon, if any, or the betterments used in forest management thereto attached, and the listers in determining such value shall consider only the value of the soil to grow timber, provided that wild lands shall be listed at not less than .... dollars or more than .... dollars per acre. The tax herein provided shall be collected yearly whether the timber or other product of the soil is taxed or is not taxed.

SECTION 2.—Stands of timber which the listers at a quadrennial appraisal determine and decide have become fully mature shall be set in the list as saw timber and shall be appraised quadrennially without regard to the value of the land. When a stand is so listed for the first time written notice of such action shall be filed by the listers with the owner of the stand, but no tax shall be levied against such timber until the next succeeding quadrennial appraisal, provided that such exemption shall not apply to stands manifestly overmature. Stands of timber which the listers at a quadrennial appraisal determine and decide have not yet become fully mature shall be exempt from taxation.

SECTION 3.—For the information of the listers the State forester shall, on January 1st of each quadrennial year transmit to the commissioner of taxes statement outlining explicitly the factors which govern the maturity of standing timber, the factors which control the

[4] Based on normal stands, Federal interest rates and future stumpage values.

value of land when used for timber production, based on stumpage prices then prevailing, and summarizing the general market prices of stumpage, logs and lumber.

The above law would necessarily be changed in wording to suit legal phraseology if submitted to the legislature, but would not be changed in principle. Sections 1 and 2 above might be combined and simplified, thus:

SECTION 1.—All soils capable of timber production and not used for a higher purpose shall be appraised according to their value to produce timber, and the listers in fixing quadrennial appraisals of timberlands shall in addition consider the value of mature stands of timber only.

In conclusion, the principle underlying such a law is understandable, the law itself is capable of administration, and is just. Ample revenue will be secured, the forest can pay the tax *if the land is kept productive,* and above all else, two blessed truths stand out clearly: First, there has been no attempt to coerce a landowner into practicing forestry; second, the regular tax machinery of the State and town needs no outside assistance to levy and collect the tax.

DEMAND FOR A CHANGE IN POLICY OF THE AMERICAN FORESTRY ASSOCIATION

April 20, 1921.

To the Officers and Directors of
the American Forestry Association:

We, the undersigned officers and members of the American Forestry Association, recognize with profound regret that the Association has adopted a course which, unless promptly corrected, forfeits its rights to the confidence of the public, and clearly invalidates its claim to represent the forest interests of the people of the United States.

First, the management of the Association has been taken out of the hands of its members. Amendments to the by-laws proposed by the Board of Directors and adopted at the annual meeting of the Association in Washington, D. C., on February 25, 1921, put the affairs of the Association into the hands of what is in effect a self-perpetuating board with unusual powers. Hereafter the Board is to consist of 15 members, of whom seven, nominated by the Directors and elected at the meeting on February 25, are to be permanent. The new by-laws authorize the nomination of the other eight by the Board, with provision for additional nominations by members if desired. The Board, thus constituted, is given power to elect the President, Vice Presidents, Treasurer, and Secretary of the Association, and to amend the by-laws, except those relating to the election of the Directors.

It would be difficult to devise an organization more undemocratic or better suited to put substantially complete control of the Association in the hands of a small group not responsible to the membership.

Second, the amended by-laws, formally expressed, were not presented to the meeting, but instead only a brief and incomplete summary of them. The advance announcement of the proposed changes, published in American Forestry, was in such a form and so inconspicuously placed as to be easily overlooked by the average reader. A proposal to secure a referendum vote of all members by mail upon this important plan of reorganization was rejected. The new by-laws do not therefore represent the deliberate action of the members of the Association.

Third, the financial management of the Association is not sound The National Information Bureau of New York City has declined to endorse the Association, first, because it has paid commissions amounting to 20 per cent on funds received above a minimum, a practice now generally regarded as improper in associations of this kind, and second, because of misrepresentations in information supplied the Bureau regarding commissions paid.

Fourth, the Association has confined its endeavors too exclusively to the work of general publicity, and has failed to take a leadership in many of the vital issues, involving Federal and State action, especially where controversies are involved.

We believe that the course taken by the present officers and Directors of the Association is undemocratic and contains elements of grave danger; and that unless promptly corrected, it will inevitably impair the confidence of the members and of the general public, and that the Association will no longer be able to play an effective part in advancing forestry in America.

Before the American Forestry Association can once more become worthy of the confidence of the public and capable of performing the functions for which it was organized, we hold:

1. That democratic control of the Association must be restored, and to that end the Board of Directors must immediately take steps to bring about the rescinding of the amendments to the by-laws adopted at the last annual meeting.

2. That the management of the Association must be brought into complete conformity with the standards established by the National Information Bureau.

3. That in addition to its general work of publicity, the Association must take a real and vigorous leadership in initiating and advancing measures to bring about the practice of forestry, even when this involves public controversy.

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Professor Emeritus, University of Toronto; former chief, U. S. Division of Forestry.

PINCHOT, GIFFORD,
Commissioner of Forestry of Pennsylvania; former chief, U. S. Forest Service; Vice President, American Forestry Association.

GRAVES, HENRY S.,
Former chief, U. S. Forest Service; Vice President, American Forestry Association.

GREELEY, W. B.,
Chief, U. S. Forest Service.

SHERMAN, E. A.,
Associate Forester, U. S. Forest Service.

ROTH, FILIBERT,
Professor of Forestry, University of Michigan; Vice President, American Forestry Association.

TOUMEY, JAS. W.,
Director, Yale Forest School.

WOODWARD, R. S.,
Former President, Carnegie Institution.

NEWELL, F. H.,
Former Director, U. S. Reclamation Service.

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MULFORD, WALTER,
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GREEN, GEO. R.,
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Urania, Louisiana.

MOORE, BARRINGTON,
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State Forester, Maryland.

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Assistant State Forester, Ohio.

MOON, FRANKLIN,
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PENNINGTON, L. H.
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KAPLAN, J. S.,
City Forester, New York City.

DANA, S. T.,
Land Agent and Forest Commissioner, Maine.

HASTINGS, W. G.,
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HALL, W. L.,
Forest Engineer, Chicago.

PETTIS, C. R.,
Superintendent of State Forests of New York.

WILSON, ELLWOOD,
Chief Forester, Laurentide Paper Co., Canada.

BRYANT, EDWARD S.,
Forest Engineer, Boston.

LEAVITT, CLYDE,
Chief Forester, Commissioner of Conservation, Ottawa, Canada.

CRAIG, ROLAND D.,
Ottawa, Canada.

HOWE, C. D.,
Dean of the Faculty of Forestry, University of Toronto.

SOUTERGUCCER, U. A.,
Assistant Superintendent of Forestry of Louisiana.

WOOLSEY, T. S., JR.,
Consulting Forester, Connecticut.

Forwarded to MR. CHARLES L. PACK by HENRY S. GRAVES, May 20, 1921.

CONFERENCE REPORT ON AMERICAN FORESTRY ASSOCIATION MATTERS

On Thursday, August 25, Col. W. B. Greeley, Col. H. S. Graves, Mr. F. W. Besley, Dr. H. S. Drinker, Mr. Chester W. Lyman, and Mr. Nelson C. Brown met by appointment at the University Club, in Washington, as an informal, voluntary committee, to confer on the questions recently agitated and discussed in regard to the By-Laws of the American Forestry Association. After a full discussion of the whole situation, they reached the following conclusions, which were laid before the Directors of the Association at a meeting held Tuesday, August 30:

(1) The provision for 7 permanent Directors was agreed to be eliminated. As to this, Col. Greeley suggested that a system somewhat similar to that which formerly prevailed in the Association could be adopted, leaving the choice and election of all the Directors wholly in the hands of the members of the Association. He suggested the substitution of an elective Board of 15 members, 3 to be elected annually by ballot by the members of the Association, to hold office for 5 years. The committee unanimously approved this suggestion.

It was further suggested that in place of the appointment of a number of permanent Directors, a plan of having a Committee of three permanent Trustees to hold the Association's endowment funds and life membership payments be considered by the Board.

(2) All non-salaried officers (at present, the President, Vice-Presidents, and Treasurer) to be elected annually by letter ballot by the members of the Association instead of by the Directors. Nominations for Directors and for the non-salaried officers to be made annually by a nominating committee of representative character appointed by the Directors, any group or groups of 25 members also to have the right to nominate tickets, to be sent out to the members by the Secretary with the ticket suggested by the Nominating Committee.

(3) The power of the Directors to amend the By-Laws to be eliminated. All amendments to be made by the members of the Association.

(4) The plan of the Directors that has been under consideration, to appoint a competent, trained and experienced forester as a member of

the working and editorial staff, under the direction of the Directors, to assist in taking the leadership in promoting forestry in the nation—was heartily endorsed and strongly recommended. It is the policy of the Directors to employ a forester for this purpose as a permanent feature of the work of the Association as soon as that can be brought about, and to place him in a responsible relationship toward the editorial policy of the magazine on forestry matters.

W. B. Greeley
H. S. Graves
F. W. Besley
H. S. Drinker
Chester W. Lyman
Nelson C. Brown

The Board of Directors of the American Forestry Association at their meeting held August 30, 1921, unanimously approved the above recommendations.

REVIEWS

Forest Resources, Lumber Industry and Lumber Export Trade of Finland. Bulletin No. 207, Special Agents Series, U. S. Dept. of Commerce. Washington, D. C., 1921. Pp. 144. Price, 30 cents.

Axel H. Oxholm is the author of this thorough study of Finland's forest resources, lumber industry, and lumber export trade. Mr. Oxholm, as Trade Commissioner of the Federal Department of Commerce, made this investigation during the latter part of 1917 and the early months of 1919. It was carried on under exceptionally trying circumstances in regard to food supplies and personal safety. Mr. Oxholm had previously made a similar study of the lumber industry of Sweden that was published as Special Agents Series No. 195.

A study of the lumber industry of Finland offers a great deal of interest on account of the extensive timberlands in this country, a large percentage of which have not yet been exploited. Finland and Russia are probably the only two countries in Europe where any large areas of virgin forests are left. Furthermore, no other country in Europe has such a large percentage of its area covered with forests or such a large area of forests *per capita* as Finland.

The management of Finnish forests has been neglected in the past, and until recently no adequate laws have been established to regulate the cutting of timbers. A new forest law came into effect during the war, and this law, in connection with the recently established export duty on small timber, etc., will greatly reduce the reckless exploitation of immature stands that has taken place in past years.

The manufacturing methods in Finland are being rapidly improved, and during late years the smaller mills have, to a large extent, been bought by the larger companies, whereby the character of the lumber for export is made more uniform. One may, therefore, look to Finland as one of the world's principal suppliers of timber and lumber products. The lumber production in Finland has not yet reached its maximum and the country may be considered as one of the most promising lumber producers in Europe.

Finland is situated in northern Europe immediately east of the Scandinavian Peninsula. Finland has its only ports in the south and west.

The total area comprises 93,263,000 acres, of which 10,943,000 acres, or about 12 per cent, are inland waters. The area is, therefore, about the same as that of the State of Montana or the combined area of the States of Minnesota and Michigan. The extension from north to south is about 660 miles and from west to east about 370 miles.

The total land area, after deducting the area occupied by cities and towns, is 82,114,000 acres, which is classified as follows: Cultivated land, 4,611,000 acres, or 5.6 per cent; meadows, 2,371,000 acres, or 2.9 per cent; forests and unproductive land, 75,102,000 acres, or 91.5 per cent.

Finland is a rather flat country and the only mountains are found in the extreme north on the Norwegian border. These mountains attain a maximum height of about 4,000 feet.

The other sections of Finland are characterized by low ridges and hills, seldom exceeding 300 to 600 feet in altitude. These ridges are usually covered with forests.

Finland is called the "Land of a Thousand Lakes," and the whole country is penetrated by a network of rivers and inland water. It is estimated that there are more than 35,000 lakes in Finland, nearly all in the southern part of the country. These waterways are of great importance to the country, because they afford a good means of transportation and particularly facilitate the floating of logs.

Numerous rivers, up to 300 miles long, penetrate the country and connect the various lakes.

A great many of the Finnish waterfalls have already been utilized for power and others will be developed in the near future. These waterfalls will play an important part in developing various industries. It has been estimated that the Finnish waterfalls can yield at least 3,000,000 horsepower when fully developed.

Owing to the prevalence of west and southwest winds, the climate in Finland is less severe than it is on corresponding latitudes in other countries. The winter lasts very long, especially in the northern and eastern sections, and early frosts often destroy the crops.

The maximum temperature during the summer is 95° F. and the minimum temperature during the winter is 49° below zero.

From October until the middle of April frequent snowfalls occur and in the northern sections of the country the snow covers the ground during the latter part of September. The snow reaches its maximum depth in March, and at this time it is about 12 to 16 inches in the south-

western, 24 to 26 inches in the southeastern, and 30 to 32 inches in the eastern and northeastern sections.

During the winter all lakes and rivers freeze over and navigation is closed.

The population of Finland is approximately 3,250,000, scattered over an area which is larger than that of Italy.

The most important lumber export port is Kotka, which is near Helsingfors, on the southern coast, and has about 12,000 inhabitants. This is one of the principal lumber export ports in Europe.

Finland belonged to Sweden prior to 1809. In that year Sweden was forced, after war with Russia, to cede Finland to the latter country, and from that time until 1917 Finland was a part of the Russian Empire. However, the position of Finland was somewhat different from that, for instance, of Poland and other parts of Russia conquered by that country in wars. A certain amount of freedom was allowed Finland during the greater part of the last century and it was left to manage its own internal affairs. The country had a Russian governor, and the diplomatic and consular representation abroad was by Russian officials. Finland was not influenced to any great extent by Russian customs and methods until about 20 or 25 years ago. During the reign of the last Czar of Russia a change took place in this respect and considerable friction resulted from the efforts of the Russian Government to introduce Russian methods and institutions in Finland.

Finland took no active part in the war, as a previous arrangement with Russia exempted the Finlanders from maintaining an army. During the war the country was shut off from the world's market through the German blockade of the Baltic Sea and very serious conditions resulted, because Finland is largely dependent on foreign countries for its food supplies. With the downfall of the Russian Empire, the Finns availed themselves of the opportunity to make Finland an independent country, which was effected during the latter part of 1917. Serious internal trouble followed in the beginning of 1918, but the revolution was suppressed by the assistance of German troops, and as recompense for this assistance the Germans practically demanded the control of the whole of Finland in both a political and economical respect. The price was extremely heavy, but at the time it was a question of life or death and there was no choice in the matter. Fortunately for Finland, the Germans were defeated in the war, and it did not have to pay the price for the assistance received. The future of Finland

depends upon internal peace. A strong organization of volunteers was established after the revolution to prevent any repetition of the experiences of 1918, and so far they have been able to maintain order.

Among the principal assets of the country are the enormous stocks of lumber and timber and other wood products manufactured and stored during the war. It was estimated at the time the armistice was signed that at least 2,500,000,000 feet of lumber, valued at approximately 850,000,000 to 900,000,000 Finnish marks ($161,000,000 to $171,000,000 par value), were stored in Finland.

Transportation facilities in Finland are good. The country possesses about 2,485 miles of railroad, 90 per cent of which is Government-owned. The railroads do not play such an important part in the lumber industry in Finland as is the case in other countries. Several of the large rivers have been navigable by a system of sluiced canals, and there are other canals connecting one river system with another. Canals connect some of the large interior lakes with the Baltic, so that steamers can go up the rivers and lakes for hundreds of miles into the interior. These canals offer important facilities for the transportation of sawlogs and lumber.

With the exception of the regions in the extreme north, practically the whole country is covered with forests, consisting mainly of pine, spruce, and birch. There are, however, certain regions near the western coast that are barren. The larger part of Finland is located within the north Baltic coniferous region. In the northern sections of the country birch forests are predominant, and in the extreme southwestern parts some oak forests are found. This southwestern forest region belongs to the central European oak region. Part of southern Finland is within the south Baltic coniferous region. Finland has very few national resources besides forests.

It was not until the middle of the last century that the great value of the forests was realized. At this time the sawmill industry started on a large scale and the foundation for the lumber, pulp, and paper export trade was laid. Since that time the forests have increased in value each year. Prior to the middle of the last century practically the only wood products exported were sawlogs, wood tar, and firewood.

The great importance of the forests is shown by the fact that the export of lumber, timber, pulp, paper, and other wood products amounted to $58,000,000 in 1913, or approximately 74 per cent of the value of the total exports of Finland.

Rational forest management in a modern sense of the word has not generally been practiced in Finland until recently. Particularly the forests owned by private individuals show evidence of a lack of rational management, and the most valuable timber in these forests has often been badly cut out.

The following table gives an estimate of the division of forest lands in Finland according to ownership:

	Acres
State	16,042 000
Cities and counties (communes)	452,000
Lumber and pulp companies	6,919 000
Private individuals	26,539 000
Total	49,952,000

The forests in private ownership are mainly in the hands of farmers, landowners, and other individuals, and their timber supply has been very severely drained in years past. These forests are, therefore, usually in a very poor state.

In contrast to these areas the forest lands in the hands of lumber companies, pulp companies, and other wood-using industries are usually very well taken care of. The largest companies have, as a rule, trained foresters to look after their property, and the cutting is usually done along scientific lines. These forests have been managed with the intention of safeguarding the supply of raw material for all time to come, and in order to attain this end considerable money is spent by these companies for reforestation, improvement of the stands, draining, etc. There is no question but that these companies are in a better position to exploit the forests in a rational way than the small individual holders, because the large companies can better afford to manage the forests efficiently.

The best forests in Finland are those in the hands of lumber and pulp companies, and the majority of privately-owned forests are found in southern Finland. There are several companies, each holding from 700,000 to 1,000,000 acres of forest lands.

The forests owned by cities and counties and the State forests are well managed and cut with due regard to the principles of forestry. The cutting is very conservative and effected according to detailed plans made in advance of each season.

In southern Finland pine and spruce forests are considered mature for cutting at about 75 to 80 years of age, in the most favorable cases. In the central parts of the country the age for cutting is about 100

or 120 years, in the southern parts of the Province of Uleaborg 120 to 150 years, and in the extreme north 200 to 250 years. By systematic forest management, the pulp companies expect to reduce the age of maturity for cutting to about 60 to 65 years, but such trees would not be suitable for sawlogs.

There are very few virgin forests left in Finland on privately-owned land. The majority of the virgin forests are in northern Finland and are generally State forests. Timber from this section is often over-mature, showing numerous defects, such as shakes, rot, and large loose knots. From an economical standpoint it would be advantageous to the country to have these virgin forests cleaned out, because better growing conditions would be given to the younger growth and the quality of the timber would be improved.

Until very recently there have been practically no laws in Finland limiting the cutting of private forests or any compulsory reforestation of cut-over lands. Reforestation has been practiced only by few of the very largest pulp and lumber companies on their holdings and by the Government in the State forests.

The government has reforested considerable areas of barren land in the State forests. In 1914, 3,351 acres were reforested; in 1913, 2,473 acres, and in 1912, 2,684 acres.

The cost per acre of forest culture in the Finnish State forests has been given as follows:

Seeding:	
Clearing of land and harrowing	$3.13
Seeding	.39
Cost of seeds	3.51
Total	$7.03
Planting:	
Clearing of land	$6.26
Planting	3.13
Transportation of plants to field	3.90
Cost of plants	5.86
Total	$19.15

The above figures refer to the war period, when the cost of labor was approximately 10 marks ($1.93 at par value) per day. Before the war the cost of labor was less than half of this amount and the cost of planting and seeding correspondingly lower. At the present time the cost of labor is at least 100 per cent higher than the above estimate.

Until about 10 years ago the State forests did not show any net profit. Before that time the operations in them had been conducted with heavy losses, due partly to unsatisfactory conditions for the selling of logs.

It is important to consider the laws regulating and restricting cutting of timber in Finland, because these restrictions will materially affect the nation's future output of timber. A short summary is therefore given of the law effective from January 1, 1918, bearing on the management of the forests.

The new law is similar to the Swedish so-called "young-forest law" and is based on the principle of compulsory reforestation. Paragraph 1 of the law reads as follows: "Young productive forests must not be cut unless such cutting is conducted in conformity with the principles of rational thinning. The forest floor must not be left in such condition after the cutting as to impair the possibilities of the natural reproduction of the forest."

As conditions for artificial reproduction (planting and seeding) at times are unfavorable in Finland, the law especially stipulates that the forests must not be cut in such a way that the possibilities for natural reproduction will be impaired in any way. Of course, the law can not give definite stipulations regarding how the forests are to be cut in each section of the country. This matter is to be decided by local authorities. The law will, it is hoped, check the practice of cutting down young trees without regard to the rules of rational forestry.

The law makes several exceptions from the stipulations laid down in paragraph 1. Young forests may be cut clean if the cut-over land is intended for agricultural purposes or for building, etc. Young forests may also be cut if the timber is being used for the personal needs of the owner, such as for firewood, building material, etc., but such cutting must always be conducted with due regard to the natural reproduction of the forests.

In order to carry on a plan of intensive forestry, it is often necessary for the forest owner to cut his timber with less restriction then laid down in paragraph 1. It was not the intention of the law to prevent such intensive exploitation of the forests, and if the forest owner can submit *a detailed plan of the intended cutting, extending through a certain period of time, and have this plan approved by a local officer appointed for this purpose*, certain modifications of the law's provisions may be granted, provided the forest owner can offer the necessary

guaranty that he will take adequate steps for the reproduction of the cut-over lands.

In each Province a special forest commission is in charge of the supervision of the cutting and the execution of the law. If it is evident that a forest area has been cut in such a way that the law has been broken, the commission will either deprive the owner for a time of the right to any further cutting on the total area of such forest or restrict the cutting on a part of the land. Necessary measures will be taken by the commission to reforest the cut-over area at the expense of the owner, if he shows unwillingness to do this work himself.

If the timber in a forest has been sold by the owner to be cut by another party, the person who contracted for the logging must report in detail to the local forest commission regarding the proposed plan for the cutting. The same rule regarding the reporting of proposed cutting of timber applies to the owner of a forest when he intends to cut timber on his holdings with a view to selling it to sawmills or other wood-using industries establishments, or otherwise to exploit his timberland for commercial purposes.

It is a noticeable fact that the Government has placed the matter of supervision in the hands of special forest commissions throughout the country who are conversant with local conditions and the problems of forest conservation. This seems to be a very practical measure, because it would be very difficult for the ordinary courts to decide whether the forest law had been violated, as it would be necessary to have detailed knowledge of the principles of forestry to pass judgment in each case.

The forest commissions, of which there is one in each Province, receive their orders from the Government Forest Service and work directly under it. The members are appointed for a period of three years and have several assistants. Each commission has three members, one appointed by the Forest Service and the other two by the Department of Agriculture. The Government defrays the expenses of the commissions. In every county or commune there is a local forest commission reporting to the provincial forest commission. Their expenses are paid by the county or commune where they operate. In case a forest owner refuses to obey the orders of the provincial forest commission, the matter is referred to the courts.

By comparing the new Finnish forest laws with the Swedish and Norwegian laws it is seen that the Finnish laws are less strict than the Swedish, but more severe than the laws in Norway. The Norwegian laws are based on the dimension of trees, which is considered

less satisfactory. Comparing conditions in Finland and in Scandinavia with those in other countries, where strong opposition is raised against any control of private timber lands and their management, it is interesting to note that the forest owners in Finland, as well as in Norway and Sweden, have loyally accepted the restrictions regarding cutting on their holdings, because they realize that they will be benefited in the end and that the nations' timber supply will be safeguarded for all times to come.

Finland is one of the few countries in Europe that has a system of forest fire insurance. A private company started in 1914 works on a plan which is a combination of the Norwegian and German systems.

The Finnish fire insurance plan covers the following four categories: Categories No. 1, young forests with trees less than 5 inches in diameter measured 18 feet from the ground; category No. 2, mature forests with trees 5 inches in diameter and over at 18 feet from the ground; category No. 3, both young and mature forests; category No. 4, forest products. Young forests may be insured for the standing trees alone or the insurance may also cover the cost of reproducing the burned-over areas of young forests. In the latter case the insurance covers only stands 15 years of age or less. The insurance of forest products covers logs, etc., during the time they remain in the forest. The insurance covering standing forests includes damage done to the forest floor by fire, if such fire impairs the soil for reforestation.

The premium per $1,000 of insurance is as follows: Category No. 1, $1.25 to $1.75 for standing timber and $3.50 to $4 for reproduction of burned-over forest lands; category No. 2, $0.75 to $1.20; category No. 3, $1.10 to $1.50; category No. 4, $5 to $6. Special discounts are given in districts having efficient fire patrol systems. In addition to regular premium, an extra premium of 50 cents per $1,000 of insurance is charged during the first year.[1]

Nearly all the larger Finnish sawmills have extensive timber holdings. The mills generally use very conservative cutting methods in their own forests. The larger mills employ forest experts and the milling and logging are entirely separated. A careful plan, extending through several years, is prepared, with due regard to the young growth and the reforestation problems. The amount of cutting in forests owned by the mills is largely dependent upon the prices of

[1] The Globe and Rutgers Fire Insurance Co. of New York offer a rate of 1½ per cent per annum on mature timber and 3 per cent per annum on young growth and plantations.

stumpage. If stumpage values are low the mills prefer to contract for timber in other forests and save their own holding.

Trees selected for cutting are carefully marked in advance of each logging season. The felling of the trees starts as soon as the first snow has fallen and the ground is frozen. Sawlogs are never cut during the spring, summer, or autumn on account of the danger of having the logs discolor. Climatic conditions vary a great deal in different parts of the country, and therefore the duration of the logging operations ranges from three to five months. As a general rule, it may be said that the logging operations start in November or December and end in March or April. In the northern sections of the country logging may begin in October. During extreme cold weather the felling of trees is suspended, because the wood becomes brittle and there is danger of its breaking.

The logging operations in Finland are carried on in about the same way as in Scandinavia, although the type of equipment may vary slightly on account of the difference in topographical conditions of these countries. Except in one case in northern Finland, where American tractors of the caterpillar type are used for hauling logs, no machinery of any kind is used in the logging operations in Finland.

Saws are generally used in felling trees. The stumps are cut very low on Government timberland and in the better-managed privately owned forests. The stumps in such forest are seldom higher than 3 or 4 inches above the ground. In other cases stumps may be left as high as 10 or 15 inches.

In the State forests the trees are at times limbed before they are felled in order to prevent damage to the surrounding young growth.

As a rule, the average length of logs in Finland is about 19 feet and the average top diameter from 7 to 7½ inches. The length of the logs in each district is dependent upon the conditions of floating, because long logs are easily broken and the cost of floating such logs is usually disproportionally higher than that for standard logs. The minimum top diameter of sawlogs may be said to be 5 inches in regions close to the mills where the cost of transportation is reasonable. It is evident, however, that in districts located at a great distance from the mill the minimum log diameter must be larger on account of higher cost of transportation. Logs longer than 35 feet can not be practically floated in Finland, and the tendency is to cut shorter lengths than has been done heretofore in order to save waste in the mills on account of the taper being smaller. The favored top dimensions are 9½, 10, 11,

11½, and 13 inches. These dimensions will yield lumber of such dimensions as are most in demand. The logs are generally "drawn out" to 4 inches at the top and the remainder is cut into firewood, props, etc.

The thousands of rivers and lakes in all parts of Finland greatly facilitate logging operations. Generally speaking, the maximum distance from the place where the logging operations are carried on to the nearest waterway is seldom in excess of 7 or 10 miles and the average distance may be about 2 to 2½ miles. In exceptional cases the distance may be 15 to 20 miles. Furthermore, the country is fairly level and no such steep hills and mountainous regions are found in the forest area of Finland as are frequently seen in Norway. Therefore, conditions for hauling logs are favorable.

The excellent floating facilities in Finland impress one immediately. A network of rivers and lakes spreads all over the country, and when the rivers have been cleared of obstructions now hampering the floating in many sections, there will hardly be any part of the forest area of Finland that can not be exploited profitably by the sawmills. The many improvements made in the Finnish waterways up to the present time have not only had a direct bearing on the supply of logs at the sawmills, but have also enhanced many fold the value of timberlands which formerly were inaccessible.

The combined length of all the Finnish rivers suitable for floating aggregates 6,000 to 7,000 miles, and before the war an average of 30,000,000 to 40,000,000 logs were floated annually in these rivers. It is estimated that a land area of about 116,000 square miles, which is about 80 per cent of the total area of the country, is adjacent to these floating rivers.

The time required for floating of logs in the rivers varies and may take only one season or as much as three seasons. Floating extending through three seasons is rare and the logs naturally depreciate considerably in quality during such long periods. The average time required in the principal Finnish rivers is two seasons. The percentage of sunken logs varies from 1½ to 3 per cent, the average being about 2 per cent.

Pine and spruce are the chief species floated, but birch is also floated to some extent, although it offers difficulties on account of its heavier weight. Recently an experiment was made in one of the principal rivers in floating birch cut into short lengths of about 3⅓ feet and 35,000 cubic feet of such stock was floated a distance of about 50 miles. The cost was about $0.003 per cubic foot. The quantity of sunken

logs was only about 3½ per cent, which is considered very favorable.

It would serve no useful purpose to go into the details of Finnish lumber manufacture and lumber export trade. This bulletin leaves no important phase untouched and is authoritative on the field which it covers. Copies may be obtained from the Superintendent of Public Documents at Washington.

A. B. R.

Yellow Birch and Its Relation to the Adirondack Forest. By E. F. McCarthy and H. C. Belyea. Technical Publication No. 12 of the New York State College of Forestry at Syracuse University, June, 1920.

The study whose results are presented in this bulletin was only part of a more general study of yellow birch. Unfortunately nothing is said as to the scope and contents of the complete study. Without knowing this it is, of course, impossible to judge whether the subject is or is not adequately covered. "This report," say the authors, "includes a fundamental discussion of the types and conditions found in the Adirondacks, and presents comparative data to show the silvicultural relation of the birch to the other species native to the region." With this promise in mind, the reviewer is forced to the conclusion that the subject has been too briefly covered and that many of the data presented cannot, because of their local nature, be employed for useful generalizations. Some of the statements made in the type description are too obviously of a presumptive nature to be convincing, however probable they may have appeared to the authors. The last criticism is not, however, characteristic of the bulletin. On the whole it is refreshingly free from dogmatism.

Silviculture in America has in the past suffered from being too subjective, and this has been largely inevitable. We have had to get along too frequently with didactic opinions, bolstered up by such scattered and too often lopsided field studies as could be made with scanty funds and a personnel of limited experience. Recently these conditions have changed; questions once answered *ex cathedra* are now given competent investigation. As a sign and symbol of the new order, the present bulletin is a welcome accession. As such, however, it cannot claim the tolerance due publications in the balmy days of our ignorance, but must meet more exacting standards and submit to more searching criticism.

There are two features of silvics which appear to have been overlooked by the authors, and a regard for which would have greatly increased the value of the bulletin.

First is the rather common fault of presenting conclusions drawn from one or a few stands as though these conclusions were valid and applicable to all stands throughout the type. There is a marked distinction, which is not clearly brought out in the text, between the silvical information which is applicable to a single stand, to a site, to a type, to a region, and finally to tree growth in general. Laws generally applicable to tree growth must, of course, be considered in the treatment of a region, type, site, or stand. The management of the stand, again, involves the application of the silvics of the region, the type, and the site where the stand is, inasmuch as the stand is within those forest divisions. The converse, however, is not true. The silvical information *peculiar* to an individual stand is not to be taken as characteristic of the entire type in which the stand is. A stand is on a certain quality of site; and the type which embraces the stand embraces a number of different sites, besides the one bearing the stand in question. Studies of a few small tracts cannot be expected, on account of the number of variants, to apply with validity to others; certainly not unless these stands are found by some suitable standards to be essentially identical in character. How to determine whether or not stands are essentially identical in character leads the thought to the second principal criticism.

This second criticism is the absence of any standard of site or "quality" or any stated criterion of site quality by which data can be compared and the application of the conclusions to other stands rendered possible. Not one set of data, not one simple statement of fact, in the publication, is definitely tied to a good criterion of site quality and, indeed, while the gross characteristics of the types are, perhaps, quite clearly described and determined, the data are only hazily referenced to them.

Silvical data should be of reliable assistance in the practice of silviculture; they should be dependable guides if they are to be of value. It may be said that the greater part of the information given in this study, as it stands, is not reliable as a guide simply because it is not referenced to site qualities.

For example: Figure 2, page 24, gives rate of growth of spruce under a stand of yellow birch, and the rate of growth given doubtless is correct for this plot. But it can be used nowhere else inasmuch

as no mention is made of the quality of site for the growth of the birch or of the spruce, nor is there any note on the density of the stand or of height of the birch. These factors must surely influence the rate of growth of the spruce.

Table 19, page 49, gives the height of old growth birch at 60 years as 38.5 feet; but Table 13, page 42, gives the height of second growth birch at 60 years as 53.6 feet. A difference of height of 15 feet at 60 years is considerable of a difference and is explained, apparently only by two facts, namely, Table 13 relates to second growth birch and was made in Franklin County, whereas Table 19 relates to old growth birch and was made in St. Lawrence County. Such explanations cannot be considered as being adequate for good use of the tables.

Again, second-growth birch of 6.5 inches d.b.h. is from Table 17, about 42 feet tall, but from Table 13 a birch of similar diameter is about 54 feet tall, while finally, from Table 19, a tree 6.5 inches diameter is about 47 feet tall. No definite explanation of these differences is found except that Table 13 was made from data gathered on the hardwood type, and Table 17 from figures obtained on the spruce flat type. But each of these types may contain a number of qualities of site for birch. No statement is given even as to the type where Table 19 was made.

Obviously such data can have little value to a forester on any piece of land in the Adirondacks. If these tables were referenced to definite factors of site (elevation, aspect, drainage, etc.) or to height of dominant mature trees, then their value could be guaged with reference to application to the area at hand.

Table 4 was made on the "hardwood" type, the same as Table 6. These tables indicate the amount of reproduction which comes in after cutting. Table 4, "all merchantable timber logged," shows 83 seedlings of sugar maple, 578 of beech, and 2,530 of yellow birch. In Table 6, where the forest was cut for "hard and soft wood" we find 1,405 sugar maple, 1,184 beech, and 1,842 yellow birch. But where, finally, the area was logged "to a diameter limit" (Table 4) we find 3,779 sugar maple, 1,036 beech, and 224 yellow birch seedlings per acre. Just what "all merchantable timber logged" "cut for hard and soft wood" and "logged to a diameter limit" means is not clearly stated.

This information as it stands unsupplemented by descriptions, is strictly "sub-lot" information. It is valid only for the spot on which it was gathered. The species of hardwood reproduction which comes in after logging unquestionably is dependent to some extent upon the

severity of removal of crown cover, but not upon that alone. The composition of the stand which was cut, the quality of the site, the culling of the stand in the years before cutting, time of year of cutting, the size of trees cut, the age of trees left standing, the amount and kind of advance reproduction, seed on the ground, etc., all are factors influencing the amount and kind of reproduction found. Without such descriptive information the data are of little value for they cannot be applied elsewhere, although, to be sure, they tell what to look for and, in general perhaps, what happens after cutting.

In many cases the quantitative validity of the information is not given. Table 12, for instance, is based on "eight sample plots scattered over 4.9 acres" but the total area of the plots is not given nor is the relative position of these plots explained. The same is true of Tables 16 and 4.

Table 4 is based on 97 sample plots which were "distributed" over 37 acres but it is not stated what system was used in "distributing" the plots. If they were placed in an arbitrary manner a certain spacing apart, then their value probably is higher (at least is probably different) than if they were placed where they would indicate, in the judgment of the investigator, the representative conditions of the tract. The latter method of "hand picking" the location of plots may be advisable under some conditions, but to do so on a silvical investigation of reproduction usually gives the impression of being afraid to trust to mathematically spaced plots for fear of not proving or substantiating a pre-established notion held by the investigators. The same criticism applies to Tables 16 and 12.

In some cases, too, the basis for the tables of growth is not given. The number of trees used in preparation of Table 8 for instance, is not given, nor is it for either Table 13 or Table 17. One is at a loss to know how much credence can be given to such information.

It is unfortunate that the "investigations of a field party of five men during the summer of 1919, together with some data previously collected," should be presented in this manner. Here is a very considerable amount of pertinent information, necessary in handling forest properties in the Adirondacks, which cannot be used in the field with a feeling of safety, largely because of the lack of supplementary descriptions of site and of forest conditions. The report looks like an attempt to give detailed average figures of silvics for an entire region; to apply to all the site qualities of the types in this

region, figures which are applicable only to the one site quality on which they were gathered.

And yet, despite its faults, it is felt that in some ways the author's attitude toward silvical studies is correct and praiseworthy. We have here the simple recital of a number of carefully made observations, mainly objective and stripped of didacticism. The unbiased inference and *a priori* assertions which have been, perhaps inevitably, a characteristic of many of the old bulletins dealing with American silviculture, are here much less in evidence. There is a freedom from academic theory and conjecture that is refreshing. It is such definite information as is here given, supported, however, by good descriptions not only of the stand and type but also of the site, which are of value in silvicultural practice. It is from such data that the practicing forester must get his ideas and working knowledge for the silviculture he should use in the woods.

For there can be no set way of handling, silviculturally, either a wild woods or a piece of badly mutilated forest. The composition or density and often both, change with nearly every acre; age classes, amount of advance reproduction, sites and types intermingle. It is futile to say that for any forest property of say 20,000 acres, such as we find usually in the United States, a particular silvicultural method must be used for every acre. The method of cutting should be adapted to suit the exigencies of the spot, and not infreqnently on an 80 acres the shelterwood, the selection, the seed tree, and the clear cutting methods may all be used to some extent. On a timber sale in such woods, the silviculturist is dictated to by the conditions of the forest and his operations are guided by his knowledge of silvical conditions. The Forest Service in California now does essentially this thing (Marking Principles, April 1, 1919). These principles say about this to the marker:

"Here are the figures concerning the growth and the reproduction for the types and sites you are working in, and here are a few ideas as to what will happen after cuttings are made. It is the best information we have at hand. Nobody in the office can tell you exactly how to mark that timber. We have confidence in your silvicultural ability. We want to get rid of the old stuff and yet get young trees of good species a-coming on. Do your best, and please do not disregard the figures we have given you."

"Yellow Birch in the Adirondacks" is of value in so far as it attempts to give such plain figures and simple ideas regarding the forest;

but to the practicing forester it would be of much more value if in the text were given a good description of the conditions and circumstances under which the data were gathered. Such descriptions are necessary for the application of the data in the field.

RUSSELL WATSON.

Local Yield Table for the Fir (Abies sachalinensis). By Dr. F. Koide and H. Nakashima. Vol. I, No. 8, Research Bulletin of the College Experimental Forests, Hokkaido Imperial University, Sapporo, Japan, March, 1921.

This bulletin, following an introduction, gives sites and stand and meterological data by months and years. There follows a description of the sample plots and the selection of the "standard" (mean sample) trees. The data are given in detail for each sample plot according to compartment, sub-compartment, slope, soil (character and depth, composition and moisture content), and site quality.

The authors then describe the method of calculating the volumes of the sample plots, of which there are twenty-seven. This is according to the usual methods followed in making yield tables. The tables follow—in the usual form—for *three* (not five) site qualities. The various graphs are added.

This fir is used chiefly for paper pulp in Japan and to some extent for construction and boxes.

The next chapter is a detailed correlation of the volumes of trees of the same height and different diameters or of the same diameter and different heights.

Dr. Terazaki is one of the two Japanese experts in measuration work attached to the Imperial Forest Experiment Stations.

A. B. R.

Volume Tables for Thujopsis dolabrata ("Hiba") and Basis on which it May be Constructed. By Wataru Terazaki, Doctor of Forestry, Forest Experiment Station, Meguro, Tokyo, Japan. Reprint from the Bull. of For. Exp. Sta. No. 19, 1920.

The first chapter covers Introduction, Materials of Investigation. The tables are headed Diameter (in feet and hundredths), height and volume (in ten cubic feet to 4 decimal points), all grouped by 6-foot height classes. These tables are based on the measurement of 1,963 trees.

The second chapter deals with the volumes of trunk in relation to site. The third with the volume of trunk in relation to diameter and total height. There is an elaborate classification table showing the distribution of the 1,963 trees.

Chapter IV deals with volume of trunks and height on breast high diameter; also the form factors. This is followed by detailed discussion.

The discrepancies of various formulæ used are set forth. There is a summary of form factors based upon the relation of the volume to the perfect cylinder as a unity.

There follows a volume table (in units of 10 cubic feet) showing the results of the calculations according to d.b.h. (which is usually taken at 4 feet even for experimental purposes) and height in units of 6 feet ("Ken").

The second part deals chiefly with the discussions of previous experimental work along these lines. This includes a large amount of mathematical demonstrations of the principles involved.

A. B. R.

Rate of Growth of Conifers in the British Isles. Bulletin No. 3 of the Forestry Commission. London: His Majesty's Stationery Office, 1920. Pp. 6. Price, 3s.

This comprehensive study of the growth and yield of planted conifers in England, Wales, Scotland, and Ireland, is the outgrowth of the war. At that time many of the older stands were being cut so that the opportunity was unique for the collection of statistics. The result is the present publication, which deserves the highest praise.

The collection of data was begun in England in August, 1917, under the Forestry Branch of the Board of Agriculture. Careful instructions as to method were issued to the officer in charge of the field work, and though certain modifications became necessary in course of time, by the end of the first year the final lines had been established. These instructions are embodied in Bulletin No. 1 of the Forestry Commission. ("Collection of Data as to the Rate of Growth of Timper.")

In December, 1917, a survey on the same lines was begun in Scotland under the Board of Trade, Timber Supply Department (Scotland). The same methods were used, and the officer in charge of the unit was previously attached for a time to the original party in order to insure uniformity. The work was extended to Ireland in February, 1919,

where it was carried out under the Department of Agriculture and Technical Instruction for Ireland. Uniformity in the various countries was further secured by conferences between the officers concerned.

The work was carried out by women assistants under the supervision of trained forest officers. The women received their training in the field. The inspection of woods, selection and survey of sample plots, marking of thinnings, etc., were made by the officer in charge; the actual measurement of the trees and the working up of field data being in the hands of the women assistants.

For a detailed description of the methods used in measuring sample plots, the reader should consult Bulletin No. 1 referred to above. A sample plot comprises a small demarcated block of forest, the area of which is accurately determined. The size of the majority of the sample plots ranged from 0.2 to 0.5 acre; it was considered better to have a large number of small plots than a few plots of, say, half an acre and over. The plots were made as large as possible, but great difficulty was experienced in finding pure, uniform, well-stocked areas of any size.

The trees of the main crop were numbered, girthed at breast-height (4 feet 3 inches above the soil), and classified on paper according to Hartig's method into five groups containing equal basal areas. The mean sample tree was then calculated for each group, and two sample trees in each group (i. e., ten trees in all) of mean girth at breast height and typical form were selected in the sample plot, felled, and measured on the ground. From the volumes of these felled sample trees the volume of the plot was calculated in the usual way. The area of the sample plot being known, the corresponding figures per acre were readily obtainable.

In addition to these plots, a certain number of smaller areas, about 0.1 acre in size, were measured, chiefly in young woods. These have been called sub-plots. They have been treated in the same way as the plots, but the volume determination has been made usually from the measurements of three sample trees selected as the mean of all the trees in the sub-plot.

The quarter-girth system[1] of measurement has been used throughout the survey. This system was adopted in preference to that employed

[1] This is one-quarter of the circumference of the tree at 4 feet 3 inches above the ground. To convert to inches of diameter multiply the inches quarter-girth by 1.27.

on the Continent, in which the diameters are measured by callipers, for the following reasons:

(1) The quarter-girth system is always used in practice in Great Britain.

(2) The tape is the simplest method of measurement, and requires less physical effort than the callipers, an important point when the measurements were carried out by women.

(3) A comparative series of measurements were made with tape and callipers on about 2,000 trees. The test was complicated by the difficulty of obtaining reliable callipers, but the conclusion reached was that where both methods of measurement are accurately carried out the difference in result is negligible.

A grand total of 1,100 sample plots and sub-plots was measured in the three countries. Of these 481 were European larch, 334 Scots pine, and 157 Norway spruce.

It was decided to base the classification of woods upon height rather than upon volume, and the following system was adopted:

The sample plots were classified according to the height reached at a standard age. An age of 50 years was selected for the following reasons:

(a) By the time a coniferous wood is 50 years old all the factors of locality should have found decisive expression in the growth of the crop, and the height growth at that age should be a reliable index to the quality of the wood. Exceptions occur, but are not likely to be numerous.

(b) It was desirable to take the lowest age at which these factors had produced decisive effect, as, the lower the standard age, the fewer sample plots need be excluded from the preliminary classification and the more data will be available for constructing the height curves upon which the final classification depends.

The range of height class in larch and spruce is from 80 to 40 feet, and in Scots pine from 60 to 40 feet. In the first two species the quality classes are numbered from I to V, quality I being the 80-foot class and quality V the 40-foot class. In the case of Scots pine the quality classes are numbered from I to III, quality I being the 60-foot class and quality III the 40-foot class. Sample plots belonging to poorer qualities than the 40-foot class were measured in all three species, but there were not sufficient data from which to construct curves or tabular statements.

Yield tables have been constructed on the above lines for larch and spruce in the British Isles and separately for Scots pine in England and Scotland. The division of the Scots pine was rendered necessary

by the following considerations: Although the height growth is so similar in both countries that the same height curves could be derived, it was found when the sample plots in each quality class were examined that the data from the two countries could not be combined. In Scotland the number of trees, basal areas, and volumes per acre were consistently higher than in England, though the remarkable fact appeared that the relationship between quarter-girth and height was not affected by this difference in stocking. No certain explanation can be given as to the cause of this difference.

It seems likely that in Britain the greatest practical utility of yield tables at the present time is in connection with problems of replanting and afforestation. On large areas suitable for planting operations there are generally to be found a few scattered plantations of one or more species, and by comparing their mean heights with the height graphs some indication may be obtained as to the quality class of the area for these species. When the quality of the locality has been determined the tables can be applied in order to assess the probable production, the rotation, and so on. As, however, they are prepared for fully-stock areas it is necessary to employ a reducing factor to allow for land not actually planted, such as rides, etc., for possible damage by wind, fire, insects and fungi. The actual factor will depend upon the nature of the area to which the figures are applied.

The yield tables enable a comparison to be made of the rate at which average woods of larch, spruce and Scots pine develop in Britain. In the following extract from the tables the 60-foot classes of larch and spruce are compared with the 50-foot class of Scots pine. These classes are taken as representing an average rate of growth for the respective species.

It will be seen that in early youth larch grows fastest and spruce slowest. This "hanging back" of spruce is typical of the species, and is found in all qualities. In volume development, however, spruce takes the lead at an early stage and maintains it throughout life. As shown in the above table, spruce yields at 30 years of age 50 per cent more volume of timber per acre than larch, and nearly double the volume of Scots pine. At 70 years of age the average spruce wood contains one and three-quarter times the volume of the average larch wood and one and a half times the volume of the average Scots pine wood. Moreover, at this age every quality of spruce except the poorest carries a higher volume per acre than even the best qualities of larch or Scots pine.

	Larch, 60-foot class	Scots pine, England, 50-foot class	Scots pine, Scotland, 50-foot class	Spruce, 60-foot class
	AGE 10 YEARS.			
Height in feet.............	11	10	10	9
	AGE 30 YEARS.			
Height in feet.............	39½	31	31	36½
Mean quarter-girth (inches)	4¼	3¾	3¾	4
Number of stems per acre..	800	1040	1230	1310
Basal area per acre (square feet)	100	93	116	146
Volume per acre (cubic feet)	1460	1130	1300	2140
	AGE 70 YEARS.			
Height in feet.............	74	62½	62½	75
Mean quarter-girth (inches)	9¾	9½	9½	11¾
Number of stems per acre..	220	270	325	230
Basal area per acre (square feet)	147	169	199	224
Volume per acre (cubic feet)	3910	4060	4880	6730

At 30 years of age the average quality class of larch produces a greater volume than the average quality class of Scots pine, but in later life the position is reversed.

Comparison with foreign tables is rendered difficult by the absence of a common standard. "Quality I" means a different thing in every table. In the British tables the method of classification adopts the same criterion for all kinds of trees, namely, a standard height for each quality class at 50 years of age, and in the statement below there have been selected from the Continental tables those classes whose mean heights at 50 years most nearly approximate to the corresponding British classes.

The yield tables show that the volume produced at 50 years by the 110-foot quality class of Douglas fir exceeds that of the 80-foot quality class larch by about 75 per cent, and a comparison between the other pairs of quality classes shows an even greater difference.

With heights of 102 feet and 90 feet respectively for Douglas fir at 50 years, the U. S. A. quality classes I and II correspond closely with British classes II and III.[2] The U. S. A. quality III (70 feet at 50 years) is below anything found in Great Britain as yet, though doubtless in the future, when the tree is planted more extensively, poorer growth will be obtained in some localities.

[2] See Hanzlik's tables, For. Quart. XII., pp. 440-452.

SCOTS PINE.

Name of yield table	Age in years	Mean Height, feet	Mean Q. G., inches	No. of stems per acre	Volume cubic feet per acre
British tables .... 1920, England, 50-foot class	30	31	3½	1,040	1,130
British tables .... 1920 Scotland, 70-foot class	30	31	3½	1,230	1,300
Schwappach .... 1907, Prussia, quality II	30	33½	3	1,595	1,165
Weise .... 1880, S. Germany, quality II	30	31	2¾	1,900	920
British tables .... 1920 England, 50-foot class	80	67	10½	221	4,470
British tables .... 1920, Scotland, 50-foot class	80	67	10½	270	5,400
Schwappach .... 1907, Prussia, quality II	80	71	8	243	3,620
Weise .... 1880, S. Germany, quality II	80	73	8¾	264	4,490

SPRUCE.

Name of yield table	Age in years	Mean Height, feet	Mean Q. G., inches	No. of stems per acre	Volume cubic feet per acre
British tables .... 1920, 60-foot class	30	36½	4	1,310	2,140
Schwappach .... 1902, Prussia, quality I	30	38	3	1,500	1,400
Flury .... 1907, Swiss Foot-hills, quality III	30	36½	3	1,800	1,860
Von Guttenberg .... 1915 Tyrolese Alps, quality I	30	33	4¼	970	1,960
British tables .... 1920, 60-foot class	70	75	12	230	6,730
Schwappach .... 1902, Prussia, quality I	70	90	8½	312	6,850
Flury .... 1907, Swiss Foot-hills, quality III	70	80½	7¼	474	7,310
Von Guttenberg .... 1915, Tyrolese Alps, quality I	70	85½	9½	321	8,000

LARCH.

Name of yield table	Age in years	Mean Height, feet	Mean Q. G., inches	No. of stems per acre	Volume cubic feet per acre
British tables .... 1920, 60-foot class	30	39½	4¼	800	1,460
Gunnar Schotte .... 1917, Sweden, quality III	30	39½	3¾	790	1,460
British tables .... 1920, 60-foot class	80	79½	11	185	4,300
Gunnar Schotte .... 1917, Sweden, quality III	80	80½	10½	127	3,700

Comparing the height growth in U. S. A. quality I with that of quality II in Britain, the trend of the two curves is found to be very different. The American trees grow comparatively slowly at first, attaining a height of 36 feet at 20 years compared with 11 feet in Britain. Between 20 and 30 years the growth is virtually the same, as increase of 25 feet of height being given by both curves; in the next decade, however, there is a marked difference in favor of the American trees, which put on 23 feet of height against the 17½ feet shown in British tables, and in the following ten years 18 feet against 14 feet in the British tables.

When the volumes of the equivalent quality classes are compared, the American woods are seen to have a lower volume for a given age and height than in Britain for the first 40 years. At 50 years U. S. A. quality I and British quality II both show a volume of 7,100 cubic feet per acre.

The marked effect of increasing exposure and elevation upon the rate of growth of larch stands out clearly from the investigation. It appears to be the most sensitive of the species in that respect. None the less, on moderately or well-sheltered slopes up to about 1,000 feet elevation in Wales, the west of England and Scotland, it is capable of producing large crops of valuable timber.

The importance of soil conditions for the growth of Scots pine comes out clearly from this review. In this respect Scots pine is in strong contrast to larch and spruce, in which soil conditions appear to play a relatively small part. The reason probably is that the latter species have been planted mainly on soils derived from the weathering of rock *in situ* yielding usually deep, fertile sandy loams or loams, and there is a wide margin of safety. Scots pine, on the other hand, has been largely planted on transported soils or on formations such as the Bagshot sands, which are initially poor in food materials, and the margin of safety is small. Moreover, the occurrence of the majority of the Scots pine on flat ground tends in the same direction, i. e., to reduce the margin of safety, for pan formation is much more liable to take place on flat than on sloping ground, the effect of which is often to hold up water and prevent the necessary aeration of the roots, besides checking root development in a downward direction.

Apart from the more recently introduced exotics such as Douglas fir and Sitka spruce, the Norway spruce is seen to be the best volume producer of English conifers. It is especially useful as a timber-producing tree at the higher altitudes, where its good height-growth and

resistance to exposure make it a more certain crop than either larch or Scots pine. Larch finds its optimum conditions on well-drained slopes at moderate elevations, where there is no great degree of exposure to the prevailing winds. Finally, the sandy soils in the valley bottoms and plains seem the natural home of the Scots pine, though it has also a place on light soils in the lower hills, which are too dry to carry larch or spruce.

The appendi contains the yield tables themselves and the graphs showing the height growths. These are in the usual form, although it is to be regretted that columns of mean annual increment and of current annual increment have been omitted. There are also tables showing the distribution of the sample plots according to countries, geology, soil, aspect, and slope.

The yield of Norway spruce at *60 years* is of exceptional interest as the following extract shows:

Site quality	Diameter, inches	Height, feet	Volume per acre, main crop	
			Cubic feet	Cords, at 90 cubic feet per cord
I	15.9	91	8,020	89.1
II	14.6	79	6,940	77.1
III	13.0	68	5,910	65.7
IV	10.9	58	4,890	54.3
V	9.2	47½	3,700	41.1

U. S. Department of Agriculture Bulletin 544, "The Red Spruce," gives the following figures based on second-growth stands, at 60 years (when the mean annual increment culminates):

Site quality	Diameter, inches	Height, feet	Volume per acre, main crop	
			Cubic feet	Cords
I	9.3	61	5,950	60
II	8.0	53	5,050	48
III	6.7	45	4,150	36

In working out the culmination of the mean annual increment in Norway spruce grown in Britain, the interesting fact brought out is that:

Quality I	culminates at	50	years with a yield of	135	cubic feet per acre.
Quality II	culminates at	55	years with a yield of	118	cubic feet per acre.
Quality III	culminates at	55	years with a yield of	99	cubic feet per acre.
Quality IV	culminates at	65	years with a yield of	82	cubic feet per acre.
Quality V	culminates at	70	years with a yield of	63	cubic feet per acre.

This indicates that the average culmination of mean annual increment of planted spruce in Britain is about 60 years and that this would, accordingly, constitute the economic rotation.

The authors of this bulletin, Messrs. Guillebaud, Steven, and Marsden, are to be congratulated on this substantial addition to the forestry literature, not only of the United Kingdom, but of the entire world.

A. B. R.

Growth in Trees. By D. T. MacDougal. Carnegie Institution of Washington, Publ. 307, 1921.

MacDougal's studies on the growth of trees by means of his dendrograph have already brought out interesting facts and show promise of others. The dendrograph gives on a revolving drum a continuous record of the minutest variations in the diameter of the tree. The essentials of the instrument are a frame of metal placed around the trunk to hold the contact points, and resting on a belt of wooden blocks: the variation in distance between a contact rod on one side of the trunk and of one end of a rod or lever on the oppsite side is traced by a pen on a recording cylinder. The instrument can be adjusted so that the record shows the variation of the trunk amplified as much as is desired up to certain limits, amplifications of from 5 to 25 times being used by MacDougal.

The trees studied include 15 species, among which are western yellow pine, Douglas fir, Monterey pine, California live oak, and beech in Maryland. It would seem that each species has its particular manner of growth.

The records show that increase in diameter is not continuous during the growing season, nor is the trunk of a tree stationary in size when it is not growing. There is a diurnal expansion and contraction, greater in some species than in others; small in California live oak, and large in the pines, Douglas fir, and spruce, but particularly large in Arizona ash. The minimum size occurs in the daytime, and maximum at night, showing that this variation is a moisture, not a temperature response. Growth is superposed on these diurnal variations.

One of the most significant conclusions (No. 6, p. 5) is that "Growth . . . depends upon environmental conditions, and no part of the observations suggested a seasonable rythmic action." The correlation between growth and soil moisture seems unmistakable. At Carmel, California where it is warm enough for growth the year round, the Monterey pine showed growth when the rains came, and ceased when the soil became dry. Western yellow pine did the same during the summer, showing two periods of growth. The correlation was shown in a particularly striking way by the response in growth of Monterey pine and of California live oak to the addition of water. Growth showed on the dendrograph within 24 hours in the former tree, and within only 2 hours in the latter.

The period of enlargement of the trunk is comparatively brief, even when the warm season is long. After enlargement ceases there is generally a certain amount of shrinkage, leaving the net gain less than would have been supposed at the termination of growth.

Some species begin growth in diameter when the buds open, as in Douglas fir, others not until the new leaves are partly or in some cases completely developed. An interesting contrast in this respect is reported by Korstian[1] in a dendrographic study of box elder and blue spruce.

BARRINGTON MOORE.

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[1] Korstian, C. F. "Diameter Growth in Box Elder and Blue Spruce." Bot. Gaz. Vol. 71, No. 6, pp. 454–461, 1921.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

The Devastation of War

In the course of an article in the *Sunday Pictorial* upon "Changes in the Countryside," Mr. Chedworth Paine shows how the war has altered rural Britain. Outwardly the principal change, he says, in the appearance of the countryside is due to the immense felling of timber, which began during the war, and is till continuing. You may see traces of it anywhere between the Cromarty Firth and North Devon. We have probably only got one-fourth of the salable timber we possessed in 1914.

The country is being denuded of "high forest timber, and only private enterprise in forestry can save us from a timber famine when the next emergency arises. The small sum allotted to the new Forestry Commission is an item of Government expenditure I do not grudge, but the commission's voice is still too weak to make the nation understand that we need an intelligible forest policy. The new farmer-owners are fast destroying the fine hedgerow timber and the copses on their land. They do it in order to cultivate their fields to the last yard. I know many a lane which was once a leafy grove where not a tree is left, and the stumps have been blown out. Productivity is more important than scenery, and we must not complain, but little is being done to make good the loss of the small woodlands and the hedgerow timber.

"I fear the time is coming when the hedges, the most distinctive feature of English scenery, may be wiped out also. Already I have seen several areas where the hedges have been destroyed. England was hedgeless up to the fourteenth century, for hedges were first planted in consequence of the change of land tenure at the time of the Black Death. After six centuries the hedges are being doomed by the new farming."

The Timber Trades Journal, May 14, 1921, page 1312.

UTILIZATION, MARKET, AND TECHNOLOGY

Wood Preservation and Fire Prevention

Refers to Hoxie's advocating of spraying pulp log piles to prevent fire and gives results of observations upon the piles sprayed by one company. The chief results were: (1) Unsprayed wood from the top of the pile contained less moisture the smaller the logs, but the smaller logs become saturated with water sooner when sprayed; (2) the wood in the lowest part of the pile is moister than that in the upper parts and that the nearest the ground wettest of all; (3) when the logs are sprayed continuously they are found to contain 52-60 per cent of water based on the total weight of the wet log (108-150 per cent calculated upon the oven dry weight of the log; (4) in no case did any of the logs under the spray from the nozzles used, dry out; (5) the spray had apparently soaked the wood to the bottom of the pile (70-75 feet); (6) wet logs were moldy, but sound.

W. H. S.

Sutermeister, E. *Spraying Wood for Preservation and Fire Prevention.* Paper, Dec. 22, 1920, pp. 21 and 30.

To Prevent Decay and Sweating

Describing the method of insulating a New England cotton mill roof to prevent decay and sweating. Seven-eighths-inch pine boards were treated in an open out-of-door concrete tank for 20 hours in creosote at a temperature of 200 degrees F. and an absorption of 6 pounds per cubic foot obtained. The boards were applied to the old roof without removing the slag with a seven-eighths-inch air space between the slag and the treated stock.

W. H. S.

Hoxie, F. J. *Treated Lumber for Insulating Roofs of Moist Factories.* Paper given at 17th Ann. Meet. Amer. Wood Preservers' Assoc., Jan., 1921, and printed later.

Spraying Log Piles

A contribution to the discussion of the feasibility of spraying log-piles for the prevention of fire, bearing upon the effect of this spraying upon decay. Muench's data are cited and experiments of the writer upon five fungi. It is shown that the moisture-decay curve varies inversely with the specific gravity of the wood. Sixty per

cent of water (15 per cent calculated upon oven dry weight) prevented decay in loblolly pine sap and 67 per cent (200 per cent on oven dry weight) in Sitka spruce. Inasmuch as it has previously been shown that logs sprayed a short time contained 52-60 per cent of water and as the pulp logs are of about the same density as the loblolly pine sap, it is concluded that spraying for fire protection carries with it no danger of favoring serious loss through decay.

Snell, Walter H. *The Relation of the Moisture Content of Wood to Its Decay.* Paper Trade Journal 72: 44-46, 2 figs, 1921, and other pulp and paper journals.

To Prevent Fire and Decay

Discusses fires in log piles and decay of pulp wood where moisture content is suitable. Suggests the placing of dry wood where it will remain dry and keeping the wet wood by spraying water on them, both to prevent fire and decay.

W. H. S.

Hoxie, F. J. *Fire Prevention in Pulpwood by Means of Artificial Fog.* Pulp and Paper Mag., Canada, Jan. 6 and 13, 1920. 15 figs.

STATISTICS AND HISTORY

Russia's Wood Stocks

A telegram from Moscow states that according to reports from the Forest Central Management for wood export, the stocks on January 1st amounted to the following:

In the five northerly and the three northwesterly Governments about 200,000 standards of specified sawed goods are ready for export. At Astrakan 1,000 standards, and in Tsaritsin 3,000 standards, which parcels have been delivered to the commissaries for foreign trade, for export to Persia.

Of the goods not specified which are taken into consideration there are in the five northerly Governments about 100,000 standards, whereof about 20,000 standards are in Petrograd and 20,000 in Archangel. In addition to this, about 7,000,000 cubic feet of timber and 200,000 cubic feet of oak and hardwoods, also 300,000 cubic feet of staves, are reported as being in existence.

The Timber Trades Journal, June 4, 1921, page 1431.

EDITORIAL COMMENT

The American Forestry Association Returns to Normalcy

On April 20 a considerable number of officers and members of the American Forestry Association presented to the Board of Directors a protest against the course taken by the Board at the annual meeting of the Association in transfering the control of the affairs of the Association to seven permanent directors. The committee further demanded a change in some of the policies of the Association. As a result of this protest, three Directors and three of the insurgent members of the American Forestry Association got together to consider the matter. On August 25 they submitted definite recommendations which were unanimously approved by the Board of Directors on August 30, 1921. Both the protest and the conference report are published elsewhere in the Journal.

By approving the recommendations embodied in the conference report the Board of Directors agreed to eliminate the provision for seven permanent directors, accepted the recommendations of the committee for the election of all non-salaried officers by letter ballot of the entire membership, to abolish the power of the Directors to amend the by-laws, and to employ a competent trained forester to guide the editorial policy of the magazine and promote forestry in the States and the Nation.

It takes a truly big man to admit his mistakes. The Directors of the American Forestry Association proved big enough men to retract the course taken by them at the last annual meeting as an unwise one. Their willingness to follow the suggestions of the committee and to place the management of the Association once more on a basis which would command the confidence of the forest profession and the public stamps them further as sincere men genuinely interested in forestry.

As long as there was danger that the management of the American Forestry Association might become autocratic and its usefulness as an organ for the promotion of forestry in this country impaired, the Journal of Forestry felt it its duty to speak its mind frankly and vigorously. The recent decision of the Board of Directors, a decision which it does not question, was made in entire sincerity and perfectly

good faith, alters the situation. As long as the Board of Directors carries out energetically and fairly the recommendations of the conference, there can be no quarrel between it and the friends of forestry. On the contrary, the Association should find foresters ready to help to make the Association and its magazine the most influential factors in the promotion of forestry in this country.

There doubtless will remain some questions in the minds of some members of the Association. Whether they are justifiable or not after the adoption of the conference report the JOURNAL does not presume to decide. The work of the JOURNAL is done and the incident so far as the JOURNAL is concerned is closed. It is free once more to devote its entire space to the discussion of technical forest problems.

THE PASSING OF THE COMMISSION OF CONSERVATION OF CANADA

It will be of interest to foresters generally to record the passing of the Commission of Conservation of Canada.

The Commission was established in September, 1909, following the enactment of legislation in May of that year by the Dominion Parliament. This action was a direct outgrowth of the great conservation movement which originated in the United States under the leadership of President Roosevelt, Gifford Pinchot, and others, a feature of which was the Conference of Governors held at the White House, Washington, May 13-15, 1908. The action of the Conference led to the appointment by the President of the National Conservation Commission during the following month, under the chairmanship of Gifford Pinchot, and to the holding of the Joint Conservation Conference at Washington, December 10, 1908, at which was endorsed the voluminous and exhaustive report of the National Conservation Commission. It was, however, the holding of the North American Conservation Congress, at Washington, February 18 and 19, 1909, which gave the specific impetus needed for the establishment of the Commission of Conservation of Canada. The Canadian delegates were Hon. Sydney Fisher, Minister of Agriculture, Hon. Clifford Sifton, and Dr. H. S. Beland, M. P. Mr. Sifton, later Sir Clifford Sifton, became the chairman of the Commission of Conservation.

It may be noted that the Canadian Commission, with a life of some 12 years, survived for a much longer period than did the National Conservation Commission in the United States.

In the legislation establishing the Commission of Conservation, it was provided that "It shall be the duty of the Commission to take into

consideration all questions which may be brought to its notice relating to the conservation and better utilization of the natural resources of Canada, to make such inventories, collect and disseminate such information, conduct such investigations inside and outside of Canada, and frame such recommendations as seem conducive to the accomplishment of that end."

The Commission was in no sense an executive or administrative body; its duties were only to study, investigate and advise. Twenty Commissioners were appointed, consisting of the Ministers of Agriculture, Interior, and Mines in the Dominion Government; the member of each provincial government charged with the administration of the natural resources of such province, and a number of prominent citizens drawn from business life and the universities. The Commissioners were to receive no salaries as such, but only reimbursement for expenses in connection with attendance at meetings, etc. The paid staff of the Commission consisted of a small number of technical experts, clerical and stenographic help, and the Secretary, Mr. James White, later appointed Assistant to Chairman and Deputy Head. The active work of the Commission was organized under the Committees on Forests; Lands; Minerals; Fisheries, Game and Fur-Bearing Animals; Press and Co-operating Organizations; Public Health; and Waters and Water-Powers.

From the inception of the Commission, particular interest was shown in forestry. A vigorous educational campaign as conducted, to stimulate public interest in forest conservation and a large amount of material was published. There was consistent advocacy of more adequate protection of forests from fires, insects and disease; the organization of forest services with duties to include timber administration; the establishment of permanent forest reserves; the adoption of the merit system of appointments in forest services; silvicultural research; land classification; forest planting; the inventorying of forest resources, scientific regulation of cutting methods, and other measures calculated to bring about the more adequate protection and administration of the forest resources of Canada. A field staff of trained foresters was built up, which had succeeded in making an excellent start toward an inventory of the forest resources of the country.

Another line of work, in which valuable progress had been made, was silvicultural research on cut-over pulp-wood lands in eastern Canada, in which was involved the financial co-operation of a number of the prominent pulp and paper companies, and either the co-opera-

tion or collaboration of some of the provincial governments, particularly that of New Brunswick.

The Act establishing the Commission was repealed, as a result of legislation which passed the House of Commons May 26, 1921. It was provided in this repeal legislation that the Governor in Council might make such orders and regulations as he might deem necessary or advisable for the carrying on and completion of the work of the Commission of Conservation by other departments of the Government and for the absorption by such other departments of such officers, clerks and employees of the Commission as they might respectively require. The Order in Council implementing this provision was passed July 20, 1921.

In the debates in the Senate and House of Commons, the principal reasons advanced for the discontinuance of the Commission were that its activities overlapped and duplicated those of the regular departments of the Government; that a substantial and necessary saving could be made by discontinuance; and that the Commission was doing work which should be done by the regular departments and was receiving credit and gaining standing and prestige thereby which ought to accrue to such departments. It was argued also that the organization of such a commission was illogical, by virtue of its independent or irresponsible status, it not being directly responsible to or under the control of any of the Ministers of the Government, but only to Parliament as a whole. A further argument was that the need for such a commission was of a temporary character only, that its proper work was finished, through having stimulated widespread interest in the conservation movement, and that the time had now arrived for its work to be taken over by the regular departments of the Government. The great value of the work done by the Commission was not questioned.

Strong arguments were advanced by other speakers, who urged the continuance of the Commission and the bringing of its administration into harmony with the desires of the Government through the appointment of an acceptable successor to Sir Clifford Sifton, who had resigned his chairmanship during the war. The valuable character of the work done by the Commission was strongly emphasized; it was pointed out that at least the great bulk of the duplication was not actual, though it might to a degree be potential, since the Commission, in selecting its projects, had to at least a very large extent avoided those which were actually being carried on by the regular departments. The need was also emphasized of an independent organization which

should be in a position to make representations alike to the Dominion and Provincial Governments, as well as to carry on other work which would not logically pertain to any administrative department.

It was accordingly urged that it would be in the interest of the country to continue the Commission, with whatever revisions of policy might be considered necessary to obviate undesirable overlapping or duplication of the work of the regular departments. These arguments were, however, unavailing, and the result is now a matter of history.

It will be observed that, in carrying out the duties laid upon it, as outlined above, the Commission was, in the very nature of the case, obligated to enter upon investigations which, to a greater or less extent, must necessarily cover matters actually or potentially within the jurisdiction of some of the administrative departments of the Government, particularly the Interior and Agriculture Departments.[1]

[1] The list of publications relating to forestry subjects alone comprises the following, all of them elegant volumes:

Forest Conditions of Nova Scotia.
Forest Protection in Canada, 1912.
Forest Protection in Canada, 1913-14.
Trent Watershed Survey.
Forests of British Columbia.

ISSUED IN PAMPHLET FORM, CONSISTING IN PART OF SEPARATES FROM ANNUAL OR OTHER REPORTS OF THE COMMISSION.

Scientific Forestry in Europe.
Diseases of Trees.
Conditions in the Clay Belt of New Ontario.
Insects Destructive to Canadian Forests.
Essential Features of a Successful Fire Protective Organization.
Fire Protection from Standpoint of Railways.
Reproduction of Commercial Species in Peterboro County, Ontario.
Forest Fires and the Brush Disposal Problem.
Forestry Situation in Quebec.
Reproduction of Commercial Species in Southern Coastal Forests of British Columbia.
Wood Fuel to Relieve Coal Shortage.
Co-operation in Forestry.
Fire Protection from Private Timber Owners' Viewpoint.
Fire Protection in Dominion Parks.
Museums Aid to Forestry.
Classification of Crown Lands of New Brunswick.
Forestry on Dominion Lands.
Forest Regeneration on Pulpwood Lands in Quebec.
Forestry Progress in Canada.
Annual Reports of Committee on Forests, contained in Annual Reports of the Commission.

It is no part of the duty of the JOURNAL OF FORESTRY to take sides in what was quite evidently a highly controversial subject, particularly as the incident is now closed, and is one which relates to another country. It is, however, in order that appreciation should be recorded of the highly valuable character of the work done by the Commission along forestry lines, and that the confident hope should be expressed that this work will be carried on, through the various governmental and private agencies within the Dominion, to its full fruition. The dropping out of the Commission will only make it the more necessary that these other agencies should extend their efforts to fill the gap thus created. The forestry situation in Canada is very closely related to that in the United States, and the foresters of both countries constitute essentially a single fraternity, as is shown by the substantial representation of Canadian foresters in the membership of the Society of American Foresters, as well as by the number of American foresters in the bordering states who have affiliated with the Canadian Society of Forest Engineers.

NOTES

To Stop Forest Fires in New York State

Four new fire prevention districts will be established in New York State as the result of the cooperation of the United States Forest Service with the New York State Conservation Commission. The four new districts which, with the areas already protected, will give protection to 90 per cent of the forested regions of the State, will be as follows: Columbia and Rensselaer Counties, embracing the foothills of the Berkshires, the Grafton section, and the foothills of the Green Mountains. Lower Hudson River in the Palisades, to include all forest land east and west of the river. The Ramapo Mountain section. The Alleghany Mountain section, covering forested areas in Alleghany and Cattaraugus Counties. Last year the Federal Government appropriated $6,000 to New York State. This year, however, as a result of a campaign for better care of the forests in which such organizations as the American Forestry Association, the American Paper and Pulp Association, the National Lumber Manufacturers' Association, and other similar organizations participated through the National Forestry Program Committee, the Weeks law was amended to largely increase the funds available for work in the several States. Last year the State of New York expended $137,000 in fire prevention, and the Federal Government $6,000. The new appropriation allots the State $22,050, these funds going to the States in proportion to their own activity in fire prevention.

In addition to providing new fire prevention districts, the Federal Service will provide the State with four forest fire engines, operated by gasoline, of the type which has already proved successful in use by the State Conservation Commission.

Penobscot Forestry Club

D. A. Crocker, of the Eastern Manufacturing Company, was elected president of the recently organized Penobscot (Maine) Forestry Club. R. E. Pineo, of Milo, timberland dealer, was elected first vice president;

H. B. Morse, of the Orono Pulp & Paper Company, second vice president; Shirley Rogers, of the Great Northern Paper Company, third vice president; and P. T. Coolidge, forestry engineer, secretary and treasurer.

The object of the club shall be the promotion of social intercourse and the study of forestry and its allied activities. Membership shall be open to any forest-school graduates and all other persons actively engaged in forest land management in eastern Maine and others recommended by the membership committee. Undergraduates of the forestry course at the University of Maine will be cordially welcomed as guests at the club's regular meetings, and visitors from out of town or people living in Bangor, who are ineligible for membership, will also be cordially welcomed as guests of members.

Regular meetings will be held on the second Friday of each month

The committee which is responsible for the organization plans consisted of Prof. J. M. Briscoe, George T. Carlisle, Jr., K. McR. Clark, P. T. Coolidge, D. A. Crocker and H. B. Morse.

Training of Forest Officers—Oxford Recommended

A report was recently issued of the Interdepartmental Committee which was asked to prepare a scheme for giving effect to the resolutions of the British Empire Forestry Conference with regard to a central institution for training forest officers.

The committee recommends that such an institution should be placed at Oxford and incorporated with the University. It should be governed by a board appointed one-half by the departments or Governments concerned, and the other half by the University.

The Board should have general charge of the higher course of training, of finance, and of administration. The director of the institution, who should be the Professor of Forestry, and the staff should be appointed by the University with the approval of the board. Pending the erection of buildings, arrangements can be made with the University for temporary accommodation. The committee says that the annual cost of the permanent staff should not at the beginning exceed £4,000 per annum.

New Tanning Material in France

The French press calls attention to the value as a tanning material of the plant known to botanists as *Acacia arabica*. Fifty-five tons of

this plant were imported into France from 1916 to 1918, and experiments made at the "Laboratoire général des productions coloniales" showed that it could be used for tanning either alone or with sumac, quebracho, and oak bark. It would appear indeed, that it might replace Sicilian sumach, of which 7,000 tons, to the value of more than two million francs, were imported into France during the year 1913. The plant is believed to grow abundantly in French West Africa, and that it may count in the future as one of the resources of the colony.

Journal of Forestry (Chinese)

The first issue of a Journal of Forestry published by the Chinese Forestry Association, Nanking, China, March, 1921, has been received recently. It is of special interest because it marks the first publication of a forestry periodical in the Chinese language.

This number contains several editorials, some original and some translated articles on forestry, reports on forestry progress in China, and news notes with reference to international forestry.

The magazine is designed to be popular in character and to serve as a means of creating public interest in forestry throughout China.

P. F. S.

SOCIETY AFFAIRS

At the invitation of Commissioner Bazeley and the Massachusetts Department of Conservation the members of the New England Section met at the Myles Standish Forest, Plymouth, on July 28, 29, and 30. They were taken down over the road in automobiles and were given a chance to see fire observation towers and town forest-fire apparatus. At the reservation plantations were inspected and the fire protective scheme studied.

The formal meetings were given over largely to a discussion of the minimum silvicultural and protective requirements needed to insure continuous forest production in New England. Mr. Ralph Staebner represented the Forest Service in these discussions. The members also were given an opportunity to have a look at historic Plymouth.

The meetings were exceedingly well attended with about sixty present, forty of whom were members or prospective members of the Section, eight guests from outside New England, and the balance employees of the Conservation Department. Twenty-six men were nominated for membership in the Society.

At the last annual meeting of the Society provision was made for the formation of an Educational Committee, a subcommittee of which has been appointed to consider standardization in the classification of forestry literature. This subcommittee is endeavoring to get together as much material as it can on the classification of forestry literature. Over a hundred copies of two proposed classification schemes have been mailed to prominent librarians and foresters in the United States and Canada soliciting their criticisms and suggestions, to which a considerable number of replies have been received. If any foresters who are interested in this subject have been overlooked the subcommittee would greatly appreciate receiving their criticisms. Copies of the classification schemes will be gladly furnished upon application to the Chairman, C. F. Korstian, Appalachian Forest Experiment Station, Asheville, North Carolina.

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// JOURNAL OF FORESTRY

VOL. XIX NOVEMBER, 1921 NO. 7

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

STATE REGULATION OF CUTTINGS ON PRIVATELY OWNED LANDS [1]

BY HON. CHARLES D. NEWTON

Attorney General of New York

Inquiry.—Has the Legislature, under the police power of the State, constitutional authority to regulate the cutting of trees upon privately owned land?

You have requested my opinion upon the extent of the constitutional authority of the Legislature, in the exercise of the police power of the State, to regulate the cutting of trees on privately owned land.

Your inquiry involves the constantly recurring conflict between present private property, as such rights have grown to be regarded, and the public welfare, present and future, as changing social and economic conditions constrain many to consider the ever increasing demands of a rapidly growing population. Your inquiry necessarily involves the question whether forest destruction has yet advanced to that degree of spoliation and public detriment that the Legislature would be justified in extending the broad police power of the sovereign to the limitation of men's methods of cutting trees on their own lands and for perfectly legal and proper purposes. That is primarily a question for the Legislature to decide, for only upon such determination by the Legislature, based on sufficient proof, can such legislation be justified.

In view of the fact that this attribute of government is not fixed; but adapts itself to constantly changing conditions, even as society,

[1] An opinion rendered by Hon. Charles D. Newton, Attorney General of New York, to Conservation Commissioner Staley, under date of June 16, 1921, in regard to the power of the legislature under police power of the State to regulate the cutting of trees on privately owned land.

its organizations, its methods, its circumstances change, an answer to your inquiry involves as much the foresight of a seer as the research and deliberation of a lawyer. Especially is this so, as our courts have recognized the necessity of measuring the validity of such statutes by the demands of the times, rather than by the rigidity of written constitutions. They have held a law an unconstitutional attempt to exercise the police power, and a few years later a similar enactment valid because of circumstances arising since the first decision, or of evidence of critical conditions existing at the time of the prior determination but not then brought to the attention of the court.

A striking example of such divergent decisions presents itself in the cases of People v. Williams (189 N. Y. 131), decided in 1907, and People v. Charles Schweinler Press (214 N. Y. 395), decided in 1915. In the Williams case a statute of 1903 forbidding the employment of adult women in factories before six o'clock in the morning and after nine o'clock in the evening was held inimical to the constitutional provisions guaranteeing to every citizen freedom of lawful employment, and as discriminative against female citizens in denying them equal rights with men. The opinion in the second case asserts that while the statutes in both cases are not substantially different in purpose, yet the two cases may be really and substantially differentiated, and says:

"So, as it seems to me, in view of the incomplete manner in which the important question underlying this statute—the danger to women of night work in factories—was presented to us in the *Williams* case, we ought not to regard its decision as any bar to a consideration of the present statute in the light of all the facts and arguments now presented to us and many of which are in addition to those formerly presented, not only as a matter of mere presentation, but because they have been developed by study and investigation during the years which have intervened since the *Williams* decision was made. There is no reason why we should be reluctant to give effect to new and additional knowledge upon such a subject as this even if it did lead us to take a different view of such a vastly important question as that of public health or disease than formerly prevailed. Particularly do I feel that we should give serious consideration and great weight to the fact that the present legislation is based upon and sustained by an investigation by the legislature deliberately and carefully made through an agency of its own creation, the present factory investigating commission."

Thus it is manifest that the necessary consideration of existing, or seriously apprehended exigencies, rather than adjudicated precedents,

renders the more uncertain and unsatisfactory an opinion on the constitutional validity of prospective legislation involving the exercise of the police power.

Attempts have been made to define the police power. But almost as often as judges have resorted to definitions of this function of government, they have admitted the difficulty, if not the impossibility, of correct and comprehensive delineation and have turned to explanation and example. However, from a few of the well night innumerable judicial opinions—few, if any, subjects of the law have been so widely and frequently discussed—it can be gleaned that it is possessed by every sovereign State (In re Jacobs, 98 N. Y., 98), is inherent in the States of the American Union (People v. Budd, 117 N. Y., 1), and it is determined as each case presents itself whether there the power was properly invoked. It rests to a large extent on those ancient maxims of the law: "So to use your own that you will not injure another," and "The safety of the people is the supreme law," and the vital principles of both must be regarded and enforced.

Usually when occasion arises for assailing a specific exercise of the police power, those who believe their rights or property invaded and hence seek to overturn the law so affecting such result, invoke the fourteenth amendment to the Federal constitution and kindred provisions in the constitutions of the States. Such provisions declare that no State "shall deprive any person of life, liberty, or property without due process of law, nor deny to any person within its jurisdiction the equal protection of the laws." Considering the effect of such constitutional guarantees, Judge Field, in Barbier v. Connolly (113 U. S., 27), significantly observes:

"But neither the amendment—broad and comprehensive as it is—nor any other amendment, was designed to interfere with the power of the State, sometimes termed its police power, to prescribe regulations to promote the health, peace, morals, education, and good order of the people, and to legislate so as to *increase the industries of the State, develop its resources, and add to its wealth and prosperity.*"

I have directed attention to the adherence of the courts to the determination of the necessity and legal propriety of the use of the police power in each case as it is presented. Your inquiry can be illumined and mainly answered by presenting some cases, both in this State and elsewhere, in which this power has been invoked to limit and restrain the owner in the use of his own property on his own land, for the

avowed purpose of promoting the welfare of the community or a considerable part thereof.

In Indiana, the Legislature has declared by act that "the use of natural gas for illuminating purposes in what are known as flambeau lights is a wasteful and extravagant use thereof, and is dangerous to the public good." The statute then forbade such use of natural gas and made the violation of the prohibition a misdemeanor. The same law also prohobited the burning of the lights which might be legally used between 8 a. m. and 5 p. m. That act was upheld as a valid exercise of the police power and as properly invoked to conserve the gas supply of the State. (Townsend v. State, 147 Ind., 624; 49 N. E., 19). It should be observed, however, that the court looked upon such gas as similar in character to fish and game, in that it came from a common reservoir underlying the lands of other persons than the defendant, each of whom had equal right with him to draw upon such supply, and any particular portion of such accumulation was not the property of any particular person until reduced to possession by him. Hence, as the court there said, one, tapping the common supply, could be so restricted as not to impair an equal right in others.

Following the principle enunciated in the Indiana case, the Court of Appeals in this State in *Hathorn v. Natural Carbonic Gas Co* (194 N. Y., 326), upheld an act of our Legislature prohibiting the drilling in a specified locality into the rock for the purpose of extracting therefrom by artificial means water impregnated with minerals and containing in solution a high percentage of carbonic acid gas, for the purpose of separating such gas from the water and vending it separate from the water. Here, as in the Indiana case, the court seemed mainly to consider that such water was drawn from a common supply and that a law prohibiting the taking of that water by such methods and in such quantities as to impair the equal rights of others was a valid legislative act.

The United States Supreme Court in *Lindsley v. Natural Carbonic Gas Co.* (220 N. Y., 61), approves the position of the State court with respect to its holding on the so-called anti-pumping law. In this case the contention having been made that the statute was invalid in that it indulged in unfair and inequitable classification, and hence discrimination, the court laid down the following rules with respect to the police power as applicable in that case and which are generally applicable to all attempts at such legislation:

"The rules by which this contention must be tested, as is shown by repeated decisions of this court, are these: 1. The equal protection clause of the Fourteenth Amendment does not take from the State the power to classify in the adoption of police laws, but admits of the exercise of a wide scope of discretion in that regard, and avoids what is done only when it is without any reasonable basis and therefore is purely arbitrary. 2. A classification having some reasonable basis does not offend against that clause merely because it is not made with mathematical nicety or because in practice it results in some inequality. 3. When the classification in such a law is called in question, if any state of facts reasonably can be conceived that would sustain it, the existence of that state of facts at the time the law was enacted must be assumed. 4. One who assails the classification in such a law must carry the burden of showing that it does not rest upon any reasonable basis, but is essentially arbitrary. *Bachtel v. Wilson*, 204 U. S., 36, 41; *Louisville & Nashville R. R. Co. v. Melton*, 218 U. S., 30; *Ozan Lumber Co. v. Union County Bank*, 207 U. S., 251, 256; *Munn v. Illinois*, 94 U. S., 113, 132; *Henderson Bridge Co. v. Henderson City*, 173 U. S., 592, 615."

The State of Massachusetts in 1845 adopted a law forbidding any person to "take, carry away or remove . . . any stones, sand or gravel from any of the beaches in the town of Chelsea," and prescribing a penalty for its violation. The defendant indicted for violating such statute did not deny the commission of the inhibited acts, but insisted that he was owner of the land from which such material was taken and that the act could not therefore apply to him, and that, if it did, it was unconstitutional and void. The object of the law was obvious, to protect the harbor of the city of Boston by preserving the integrity of its beaches and natural embankments. The position of defendant was condemned, and the validity of the act sustained (Commonwealth v. Tewksbury, 11 Met., 55), the court saying:

"The court are of opinion that such a law is not a taking of the property for public use, within the meaning of the constitution, but is a just and legitimate exercise of the power of the legislature to regulate and restrain such particular use of property as would be inconsistent with, or injurious to, the rights of the public."

It then refers to the disastrous effects upon Plymouth harbor of the cutting away of wood upon its beaches and the great consequent expense to both State and Federal governments of the artificial restoration of such beaches, and concludes:

"Without hazarding an opinion upon any other question, we think that a law prohibiting an owner from removing the soil composing

a natural embankment to a valuable, navigable stream, port or harbor, is not such a taking, such an interference with the right and title of the owner, as to give him a constitutional right to compensation, and to render an act unconstitutional which makes no such provision, but is a just restraint of an injurious use of the property, which the legislature have authority to make."

The reference to Plymouth Beach in this opinion, above noted, is significant in that the opinion says:

"*In consequence of cutting away the wood upon it* or from some other cause, it was washed away and broken through by the wind and sea, and the navigation was in danger of being wholly destroyed."

The fair inference from the opinion is that it was within the power of the State to have forbidden the cutting of shore-protecting trees as well as to prohibit the removal of sand and gravel serving the same purpose and without compensation to the owner. This case is cited in 159 U. S., 399 as illustrative of the exercise of the police power and without unfavorable criticism of its doctrine. In *Hodges v. Perine* (24 Hun., 516), an act of the Legislature (Chap. 190, Laws 1878) made it a misdemeanor for any person to remove sand or other similar material from the beach of the South Shore of Staten Island opposite and contiguous to the boulevard from within twenty feet of ordinary high water mark so as to injure such highway. An owner of land within the prohibited area sought an injunction restraining certain persons, acting under authority of this law, from entering on his premises and interfering with their use, and from threatening the crews of vessels loading sand from such beach. A temporary injunction was dissolved, and the validity of the law sustained on the authority of the Tewksbury decision above quoted.

The latest word of our highest court upon the question of the proper exercise of the police power is found in *People ex rel* Durham Realty Corp. v. La Fetra (230 N. Y., 429), decided in March, 1921. Here was involved the constitutionality of the so-called "Rent Laws" of September, 1920. These enactments wrought radical changes in the law of landlord and tenant, permitting the tenant to retain the use of the demised premises upon his payment of a reasonable rent, the reasonableness of such rent being a question of fact, for a jury, although the landlord might be unwilling to continue the lease for such consideration. This series of statutes also suspended the landlord's remedy by summary proceedings. The period of operation of these laws was fixed at two years; and they were passed expressly to meet the emer-

gency of rent profiteering in the city of New York. They operated to deprive the owner of his real estate during the term of their existence, provided only compensation fixed by another, not by such owner, was paid by the occupant; and attack was made upon these laws upon the grounds that they impaired the obligations of contracts as they applied in some instances to rentals fixed by agreement before the act took effect; that they deprived the owner of his property without due process of law; that they denied to the owner equal protection of the laws, and that they took private property for private use without compensation. The Court of Appeals upheld this drastic legislation upon the ground of the dire and acute emergency in the lack of dwellings for the people of congested centers of population and the advantage being taken of that situation by selfish landlords to extort exorbitant and oppressive rents.

In the prevailing opinion by Judge Pound, the basic principles governing the exercise of the police power under the recognized existing emergency was well stated as follows:

"The question comes back to what the state may do for the benefit of the community at large. Here the legislation rests on a secure foundation. (*Chicago & Alton R. R. Co. v. Tranbarger*, 238 U. S., 67, 76, 77.) The struggle to meet changing conditions through new legislation constantly goes on. The fundamental question is whether society is prepared for the change. The law of each age is ultimately what that age thinks should be the law. Decisions of the courts in conflict with legislative policy, when such decisions have been thought to be unwisely hard and stiff, have been met by constitutional amendments . . ."

The United States Supreme Court has sustained the doctrine of the LaFetra case in Marcus Brown Holding Co. v. Feldman (N. Y. Law Journal, April 23, 1921).

The expression of judicial opinion, bearing most directly on the question you propound, which I have been able to discover, occurred in the State of Maine. (Opinion of Justices, 103 Me., 506; 69 Atl., 627.) There, under a peculiar provision of the constitution of that State, the Legislature could request, in advance, the opinion of the judges of the Supreme Court of that State on the constitutionality of a proposed law. Under that constitutional authorization, the Senate of Maine requested of the judges of the Supreme Judicial Court an opinion on the constitutional validity of a contemplated act; and the importance of their opinions as bearing on the matter before me, warrants some detailed attention to that inquiry and its determination.

On March 27, 1908, the Senate requested an opinion thus:

"In order to promote the common welfare of the people of Maine by preventing or diminishing injurious droughts and freshets, and by protecting, preserving, and maintaining the natural water supply of the springs, streams, ponds, and lakes and of the land, and by preventing or diminishing injurious erosion of the land and the filling up of the rivers, ponds, and lakes, and as an efficient means necessary to this end, has the Legislature power under the Constitution:

(1) By public general law to regulate or restrict the cutting or destruction of trees growing on wild or uncultivated land by the owner thereof without compensation therefor to such owner?

(2) To prohibit, restrict or regulate the wanton, wasteful, or unnecessary cutting or destruction of small trees growing on any wild or uncultivated land by the owner thereof, without compensation therefor to such owner, in case such small trees are of equal or greater actual value standing and remaining for their future growth than for immediate cutting, and such trees are not intended or sought to be cut for the purpose of clearing and improving such land for use or occupation in agriculture, mining, quarrying, manufacturing, or business or for pleasure purposes or for a building site; or

(3) In such manner to regulate or restrict the cutting or destruction of trees growing on wild or uncultivated lands by the owners thereof as to preserve or enhance the value of such lands and trees thereon and protect and promote the interests of such owners and the common welfare of the people;

(4) Is such regulation of the control, management or use of private property a taking thereof for public uses for which compensation must be made?"

Six of the eight judges of that court joined in sustaining such power in an opinion, the vital part of which is:

"Regarding the question submitted in the light of the doctrine above stated (being that of Maine and Massachusetts at least), we do not think the proposed legislation would operate to 'take' private property within the inhibition of the Constitution. While it might restrict the owner of wild and uncultivated lands in his use of them, might delay his taking some of the product, might defer his anticipated profits, and even thereby might cause him some loss of profit, it would nevertheless leave him his lands, their product, and increase untouched, and without diminution of title, estate, or quantity. He would still have large measure of control and large opportunity to realize values. He might suffer delay, but not deprivation. While the use might be restricted, it would not be appropriated or 'taken.'"

"There are two reasons of great weight for applying this strict construction of the constitutional provision to property in land: (1) Such property is not the result of productive labor, but is derived solely

from the state itself, the original owners; (2) the amount of land being incapable of increase, if the owners of large tracts can waste them at will without state restriction, the state and its people may be helplessly impoverished and one great purpose of government defeated."

From the few decisions to which I have referred, it can be deduced that the domain of the police power is mutable coincidentally with the changes in society, that is must appear convincingly to the court that a public emergency, present or reasonably anticipative, exists that demands a remedy not available without curtailing usually recognized private rights of property or action, that the restrictions or limitations placed upon individuals apply equally to all within the same prescribed class or classes, and that the means adopted are reasonably designed to attain the objects sought.

In the gas and mineral water cases, the courts sustain the exercise of the police power upon the ground that the prescribed acts impair the equal rights of others possessing identical interests in a common supply. In the cases prohibiting the removal of sand from the seashore and restricting the cutting of trees on privately owned land; the authorization for the use of this extreme power is placed on the broad basis of the public necessity of adequate transportation and the protection of the water supply of the State. In modern society facile means of transportation of men and commodities are absolutely indispensable to human existence. Likewise if the flow of rivers ceases, and lakes and ponds supplying such streams violently fluctuate from flooded banks to shallow basins, the power propelling factories and mills, and the waters for public and general consumption may become so irregular and uncertain in their flow that industry would wane, unemployment would increase, health would be impaired, fires would destroy accumulated wealth, and the resources of the State would disappear even as they have been destroyed by war. In like manner the vast forests of the State have so disappeared from the activities of man that the materials much used in constructing the homes of men are obtainable only in more and more remote and inaccessible places and have so risen in cost that, due in part to such conditions, thousands of people are without homes suitable and proper for their physical, mental and moral growth and welfare.

If, therefore, it can be shown to the satisfaction of the Legislature and the courts that the cutting of immature trees, coniferous or hard, or both, on private lands, has so contributed, or is likely so to con-

tribute, to such disastrous consequences as to actually threaten the sources of the water supply, indispensable to the life of the people, or even the present or future protection of timber necessary for the industries by which the people in large parts of the State live and for the construction of habitations in which they may dwell, then I am inclined to think that to meet such a crisis the Legislature may properly, within its constitutional power, limit the right of an individual to use his own without regard to effect upon his fellows, and to compel him to consider the higher and greater right of the safety of the whole people in his use and application of that which only by the grace of the State, that is, the people, he is permitted to possess.

"As was said by Chief Justice Shaw, 'it is a settled principle, growing out of the nature of well ordered civil society, that every holder of property, however absolute and unqualified may be his title, holds it under the implied liability that his use of it may be so regulated, that it shall not be injurious to the equal enjoyment of others having an equal right to the enjoyment of their property, nor injurious to the rights of the community.' *Commonwealth v. Alger*, 7 Cush., 53, 84, 85."

(St. Louis & San Francisco Ry. v. Mathews, 165 U. S., 1, 23.)

If to protect an individual or a number of individuals in their common rights, if to insure free passage from place to place of people and commodities for the benefit of the public welfare and the progress of society, the law can say that men shall use, or refrain from using, in a specified manner, their land and its products, why can not the same power of the State direct and control individual effort so as to prevent the destruction or diminution of natural resources, as vital to the general welfare and as essential to commerce as harbors for ships and roads for vehicles? Surely the full, free development of the subject-matter of commerce, is as necessary, as vital, as generally beneficial, as the means by which the products of man's industrial efforts are distributed. Without production there can be no transportation; and without consumers there is no need of either.

In drafting an act to effectuate such purpose, the rules and principles which I have attempted generally to outline should be observed. A substantial deviation from them would jeopardize the law. A strict adherence to them, especially in showing the emergency to exist, may impel the legislative branch of government to enact, and constrain the judicial branch to sustain, a tree-conserving law.

I have refrained from submitting the form of the proposed Act. I do that on this ground. I do not consider it, in any way, the function of this office to formulate the policy which will govern another department in the absence of a statute specifically placing such duty upon the Attorney-General. Your inquiry goes to the legal question of power, not to the present necessity of such legislation, which is a question of policy for the Legislature. "The scope of judicial inquiry in deciding the question of *power* is not to be confused with the scope of legislative considerations in dealing with the matter of policy" (People ex rel Durham v. La Fetra, supra). Nor should you overlook the fact that this opinion, given in answer to your very general inquiry, is of necessity academic in character and should not be construed as approving or disapproving any specific act. I can pass on such proposed law only when its form and substance are submitted to me.

THE WILDERNESS AND ITS PLACE IN FOREST RECREATIONAL POLICY

By Aldo Leopold

U. S. Forest Service

When the National Forests were created the first argument of those opposing a national forest policy was that the forests would remain a wilderness. Gifford Pinchot replied that on the contrary they would be opened up and developed as producing forests, and that such development would, in the long run, itself constitute the best assurance that they would neither remain a wilderness by "bottling up" their resources nor become one through devastation. At this time Pinchot enunciated the doctrine of "highest use," and its criterion, "the greatest good to the greatest number," which is and must remain the guiding principle by which democracies handle their natural resources.

Pinchot's promise of development has been made good. The process must, of course, continue indefinitely. But it has already gone far enough to raise the question of whether the policy of development (construed in the narrower sense of industrial development) should continue to govern in absolutely every instance, or whether the principle of highest use does not itself demand that representative portions of some forests be preserved as wilderness.

That some such question actually exists, both in the minds of some foresters and of part of the public, seems to me to be plainly implied in the recent trend of recreational use policies and in the tone of sporting and outdoor magazines. Recreational plans are leaning toward the segregation of certain areas from certain developments, so that having been led into the wilderness, the people may have some wilderness left to enjoy. Sporting magazines are groping toward some logical reconciliation between getting back to nature and preserving a little nature to get back to. Lamentations over this or that favorite vacation ground being "spoiled by tourists" are becoming more and more frequent. Very evidently we have here the old conflict between preservation and use, long since an issue with respect to timber, water power, and other purely economic resources, but just now coming to

be an issue with respect to recreation. It is the fundamental function of foresters to reconcile these conflicts, and to give constructive direction to these issues as they arise. The purpose of this paper is to give definite form to the issue of wilderness conservation, and to suggest certain policies for meeting it, especially as applied to the Southwest.

It is quite possible that the serious discussion of this question will seem a far cry in some unsettled regions, and rank heresy to some minds. Likewise did timber conservation seem a far cry in some regions, and rank heresy to some minds of a generation ago. "The truth is that which prevails in the long run."

Some definitions are probably necessary at the outset. By "wilderness" I mean a continuous stretch of country preserved in its natural state, open to lawful hunting and fishing, big enough to absorb a two weeks' pack trip, and kept devoid of roads, artificial trails, cottages, or other works of man. Several assumptions can be made at once without argument. First, such wilderness areas should occupy only a small fraction of the total National Forest area—probably not to exceed one in each State. Second, only areas naturally difficult of ordinary industrial development should be chosen. Third, each area should be representative of some type of country of distinctive recreational value, or afford some distinctive type of outdoor life, opportunity for which might disappear on other forest lands open to industrial development.

The argument for such wilderness areas is premised wholly on highest recreational use. The recreational desires and needs of the public, whom the forests must serve, vary greatly with the individual. Heretofore we have been inclined to assume that our recreational development policy must be based on the desires and needs of the majority only. The only new thing about the premise in this case is the proposition that inasmuch as we have plenty of room and plenty of time, it is our duty to vary our recreational development policy, in some places, to meet the needs and desires of the minority also. The majority undoubtedly want all the automobile roads, summer hotels, graded trails, and other modern conveniences that we can give them. It is already decided, and wisely, that they shall have these things as rapidly as brains and money can provide them. But a very substantial minority, I think, want just the opposite. It should be decided, as soon as the existence of the demand can be definitely determined, to provide what this minority wants. In fact, if we can foresee the demand, and make provision for it in advance, it will save much cash and hard feel-

ings. It will be much easier to keep wilderness areas than to create them. In fact, the latter alternative may be dismissed as impossible. Right here is the whole reason for forehandedness in the proposed wilderness area policy.

It is obvious to everyone who knows the National Forests that even with intensive future development, there will be a decreasing but inexhaustible number of small patches of rough country which will remain practically in wilderness condition. It is also generally recognized that these small patches have a high and increasing recreational value. But will they obviate the need for a policy such as here proposed? I think not. These patches are too small, and must grow smaller. They will always be big enough for camping, but they will tend to grow too small for a real wilderness trip. The public demands for camp sites and wilderness trips, respectively, are both legitimate and both strong, but nevertheless distinct. The man who wants a wilderness trip wants not only scenery, hunting, fishing, isolation, etc.—all of which can often be found within a mile of a paved auto highway—but also the horses, packing, riding, daily movement and variety found only in a trip through a big stretch of wild country. It would be pretty lame to forcibly import these features into a country from which the real need for them had disappeared.

It may also be asked whether the National Parks from which, let us hope, industrial development will continue to be excluded, do not fill the public demand here discussed. They do, in part. But hunting is not and should not be allowed within the Parks. Moreover, the Parks are being networked with roads and trails as rapidly as possible. This is right and proper. The Parks merely prove again that the recreational needs and desires of the public vary through a wide range of individual tastes, all of which should be met in due proportion to the number of individuals in each class. There is only one question involved—highest use. And we are beginning to see that highest use is a very varied use, requiring a very varied administration, in the recreational as well as in the industrial field.

An actual example is probably the best way to describe the workings of the proposed wilderness area policy.

The Southwest (meaning New Mexico and Arizona) is a distinct region. The original southwestern wilderness was the scene of several important chapters in our national history. The remainder of it is about as interesting, from about as large a number of angles, as any

place on the continent. It has a high and varied recreational value. Under the policy advocated in this paper, a good big sample of it should be preserved. This could easily be done by selecting such an area as the headwaters of the Gila River on the Gila National Forest. This is an area of nearly half a million acres, topographically isolated by mountain ranges and box canyons. It has not yet been penetrated by railroads and to only a very limited extent by roads. On account of the natural obstacles to transportation and the absence of any considerable areas of agricultural land, no net economic loss would result from the policy of withholding further industrial development, except that the timber would remain inaccessible and available only for limited local consumption. The entire area is grazed by cattle, but the cattle ranches would be an asset from the recreational standpoint because of the interest which attaches to cattle grazing operations under frontier conditions. The apparent disadvantage thus imposed on the cattlemen might be nearly offset by the obvious advantage of freedom from new settlers, and from the hordes of motorists who will invade this region the minute it is opened up. The entire region is the natural habitat of deer, elk, turkey, grouse, and trout. If preserved in its semi-virgin state, it could absorb a hundred pack trains each year without overcrowding. It is the last typical wilderness in the southwestern mountains. Highest use demands its preservation.

The conservation of recreational resources here advocated has its historic counterpart in the conservation of timber resources lately become a national issue and expressed in the forestry program. Timber conservation began fifteen years ago with the same vague premonitions of impending shortage now discernible in the recreational press. Timber conservation encountered the same general rebuttal of "inexhaustible supplies" which recreational conservation will shortly encounter. After a period of milling and mulling, timber conservation established the principle that timber supplies are capable of qualitative as well as quantitative exhaustion, and that the existence of "inexhaustible" areas of trees did not necessarily insure the supply of bridge timber, naval stores, or pulp. So also will recreational resources be found in more danger of qualitative than quantitative exhaustion. We now recognize that the sprout forests of New England are no answer to the farmer's need for structural lumber, and we admit that the farmer's special needs must be taken care of in proportion to his numbers and importance. So also must we recognize that any number of small patches of uninhabited wood or mountains are no answer to the real sportsman's need for wilderness, and the day will come when we must admit that his special needs likewise must be taken care of in proportion to his numbers and importance. And as in forestry, it will be much easier and cheaper to preserve, by forethought, what he needs, than to create it after it is gone.

THE PROBLEM OF THE REGIONAL VOLUME TABLE

By Donald Bruce

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Not so very many years ago decided differences of opinion existed between foresters as to the relative merits of regional and local volume tables. In the early days of the profession few of the former had been prepared and as each man needed a table for some specific end he was forced to compute one for himself. Thus it came about that in this early period the local table was very prevalent. Many of them, however, were hastily prepared from inadequate data and were none too reliable, so that a reaction towards the second type was a quite natural consequence. A few years later the Forest Service had published a fairly complete set of regional tables, each based on a substantial number of tree measurements, and the local table became nearly obsolete.

Many arguments have been advanced in favor of each type, but these arguments have usually been supported by purely deductive reasoning unaccompanied by conclusive experimental evidence, and the change which came about seems to have been more the result of circumstance than of investigative research. The modern regional table itself is accordingly not beyond suspicion. A salient point of doubt, of course, is in the definition of region. It has been tacitly assumed that the entire range of such species as western yellow pine or Douglas fir must be subdivided, but the decision as to the number of regions to be recognized and the determination of the boundaries between them have been too often handled on an opportunist basis. The boundaries of National Forest districts have been scrupulously respected, while pronounced physiographic frontiers have sometimes been ignored. The western yellow pine of northeastern California, for example, is far more similar to that of the Klamath region of Oregon than to that of the western Sierras, yet for volume table purposes it is the last two that have been combined.

It would seem that the experience of a decade of use should have told us which tables are good and which are not. Unfortunately, however, the form of the table has not been sufficiently standardized to per-

mit either ready comparison between tables or easy checking of any given table.[1] The employment of varying standards of utilization alone is an almost insurmountable obstacle to either.[1]

It was with this doubt in mind that a critical analysis[2] of the standard Forest Service white fir (*A. concolor*) volume table for California was undertaken, a study which resulted in the preparation of three new tables. In the course thereof a number of points came up which seem to have a bearing on the general problem of volume table preparation and of the specific question already mentioned.

A CHECK OF THE EXISTING TABLE

The table under consideration (published in loose leaf form as Form 874 nn.) is based on 1,143 trees from the Plumas, Sierra, Stanislaus, and Tahoe National Forests. It is commonly used, however, for all other Forests in California where white fir is found. Its chief drawback aside from the possibility that it covers too wide a region, is that heights are taken to a variable top cutting limit ranging from 9 to 15 inches, d. i. b.

This table was checked against its own basic tree measurements,[3] with the following results:

TABLE 1.—*A Check of Forest Service Standard Volume Table for White Fir.*

Forest	Number of trees	Scaled volume	Volume by table	Aggregate difference, per cent	Average deviation, per cent
Stanislaus (1911)......	468	96,186	103,673	— 7.4	13.9
Stanislaus (1909)......	436	119,762	117,191	+ 2.2	13.9
Stanislaus (other).....	20	3,917	3,515	+11.4	14.4
Sierra.................	50	17,510	11,395	+53.6	54.7
(Sequoia...............	6	572	512	+11.7	25.3)
Tahoe..................	40	8,683	9,211	— 5.7	15.5
Plumas.................	88	14,305	16,860	—15.2	19.4
(Lassen................	6	977	1,232	—20.7	21.0)
(Shasta................	34	1,058	1,036	+ 2.8	18.2)
Totals and averages...	1,148	264,118	264,625	— .19	16.5

[1] The writer has already enlarged on this point in "The Height and Diameter Basis for Volume Tables," JOURNAL OF FORESTRY, Vol. 18, No. 5, p. 549 f. f.

[2] Acknowledgment is made to officers of District Five, U. S. F. S., for assistance, encouragement, and helpful criticism in this work.

[3] The method of checking was that described by the writer in "A Proposed Standardization of the Checking of Volume Tables," JOURNAL OF FORESTRY, Vol. 18, No. 5, p. 544 f. f.

In the above tabulation each locality was in general kept separate, though in cases where only a small number of tree measurements had been used on a single Forest, no subdivision of this Forest was attempted. Included therein are, moreover, three groups (identified by parentheses) which were perhaps not used in the original preparation of the table, they check, however, as well as others that were used, and are an unimportant factor in the totals. The total number of trees does not exactly correspond with the figure printed on Form 874nn, due to the fact that it was not always possible to tell just which data sheets had been discarded, but the difference is too small to be material.

It will be seen that the total aggregate difference of 0.19 per cent is beyond criticism but that the corresponding average deviation of 16.5 per cent is suspiciously high. The reason for this is evident on examining the detailed figures, for even the aggregate differences of individual groups of trees are absurdly large. Some of these groups are, of course, too small to be very significant, but there is no excuse for a difference of over 7 per cent in 468 trees, or of 54 per cent in 50 trees. It is obvious that the table has combined very diverse values into an average which is of little meaning, for in practical use, it is not customary to combine tree measurements from widely separated Forests, and hence the compensation of errors which appears in Table 1 cannot be counted on.

The question arises whether the difference which is so obvious between the different groups is due to form. The next most probable alternative is a difference in top utilization. An investigation of the two largest groups disclosed decided variations in the latter and such as might account largely for the discrepancy between the two aggregate deviations. Varying top cutting limits, therefore, are probably one cause of the unsatisfactory results of Table 1, but it is possible that variations in form also had an influence. That this was the case is proved by the results hereinafter to be described.

THE BASIC DATA FOR THE STUDY

Further progress now seemed to necessitate the preparation of several different volume tables, perhaps using data combined in different ways. In addition to the basic data already described there were available for this study about 800 tree measurements taken under the direction of Dr. E. P. Meinecke, of the U. S. Bureau of Plant

Pathology, and by him most kindly made available for this work. The diameter measurements on these trees were taken, however, at varying heights dependent on the location of rot within the boles, and did not always extend far enough into the tops to be useable. About half of these data had to be discarded on this account.

The Forest Service data, moreover, having been collected at many different places and by different observers, were none too well standardized in form.

THE TAPER CURVES

Obviously the only way in which such data could be combined, was by drawing taper curves for each height-diameter class. This was therefore done, the class intervals adopted being 2 inches for d. b. h., 16 feet for total height, and a separate set of curves being prepared for each major locality. The resulting curves numbered over 400, not including a considerable number which had to be thrown out due to inadequate data.

FORM QUOTIENTS

It was obviously desirable to combine as many as possible of the groups and so have the minimum number of volume tables. As a criterion of the advisability of attempting this, the form quotient for each taper curve was calculated. For simplicity, this was defined as the ratio between d. i. b. at the mid-point and d. b. h. Tables were prepared for each group giving form quotients by height and diameter classes. A characteristic result follows in Table 2.

It seems fairly evident in this case (and all other cases were similar) that form quotients do not vary with either height or diameter to a perceptible degree, within a given group. An average form quotient may, therefore, be used for each such group. When these were calculated, it was found that they ranged from a minimum of .53 to a maximum of .61. A few rough tests made it obvious that form factors varied more, rather than less than form quotients, so the above figures meant differences of form between localities of at least 15 per cent.[4] This is obviously too great to justify combination into a single volume table.

[4] As will be shown later the form differences were finally found to exceed 20 per cent.

TABLE 2.—*Form Quotients of 424 Trees (Stanislaus Forest).*

D.b.h.	Total height in 16-feet logs.										
	5	6	7	8	9	10	11	12	13	14	15
18	...	.63	...	...	...	...	...	...	...	...	...
20	.61	.56	.64	.52	...	...	...	...	...	...	...
22	...	.62	.62	.65	.61	...	...	...	...	...	...
24	.63	.56	.59	.63	.68	...	...	...	...	...	...
26	...	.61	.64	.59	.66	.67	...	...	...	...	...
28	...	...	.61	.60	.63	.66	...	...	...	...	...
30	...	.66	.62	.59	.62	.60	...	.68	...	...	...
32	...	...	.53	.61	63	.64	.58	...	...	...	...
34	...	...	...	.62	.60	.62	.62	...	...	...	...
36	...	...	.70	.62	.60	.61	.61	.61	...	...	...
38	...	...	...	...	.58	.59	.63	.67	...	...	...
40	...	...	...	.60	.57	.60	.64	.63	...	...	...
42	...	...	...	...	.56	.64	.60	.59	...	...	...
44	...	...	...	.56	.57	.60	.57	.59	.55	...	...
46	...	...	...	...	.58	.71	.58	.64	.52	.64	...
48	...	...	...	...	.59	.66	.62	.60	...	...	...
50	...	...	...	...	.64	.52	.51	.55	.56	.55	...
52	...	...	...	...	...	.67	.59	.62	.61	...	.67
54	...	...	...	...	...	...	.58	...	.52	.61	...
56	...	...	...	...	...	.70	.62	.63	...	...	...
58	...	...	...	...	...	...	...	.51	.56	...	...
60	...	...	...	...	...	.64	...	.55	.55	...	...
62	...	...	...	...	...	...	.61	...	...	...	...
64	...	...	...	...	...	...	...	...	...	...	...
66	...	...	...	...	...	...	...	...	.49	...	...
Weighted Average....	.62	.60	.61	.61	.62	.62	.60	.60	.54	.60	.67

To make more than one table, would, however, be wasted effort, leading merely to confusion, unless some simple method could be devised to enable an estimator to tell which table should be used for any given stand. This must depend, of course, on the basic cause of form difference. Although there are probably many such, the most important (setting aside for the moment regional location) can be assumed to be either age or site. The former is hopelessly unuseable, since the basic tree measurements had not been accompanied by age determinations and since the average age of a stand can not be simply and accurately determined in the field, particularly if it be very uneven-aged. The latter seemed almost equally unpromising, but there was one possible line of attack. If maximum height be taken as a site index, not only could the groups of tree data be classified, but any stand under consideration could be similarly identified by an estimator.

This plan was therefore attempted. After several trials it was decided to use the average height of the tallest 10 per cent of the trees as the index. The result follows:

TABLE 3.—*Relation of Form Quotient to Maximum Height.*

Locality	Average form quotient	Average total height in feet
Smith Mill (near Truckee)	.531± .005	133
Deer Camp (Siskious)	.541± .004	144
Ellis Meadow (Sierra N. F.)	.581± .004	155
Crocker (Yosemite)	.581± .009	176
Stanislaus (Group 2)	.581± .007	192
Stanislaus (Group 1)	.611± .002	198

It will be observed that the correlation between form quotient and maximum height is fairly satisfactory. It was, therefore, considered safe to combine into two additional groups, on the basis of maximum height, a relatively small additional number of tree measurements from scattered localities, and this was done.

Form Factor.—An attempt was made to work out a converting factor from form quotient to frustum form factor, but this was unsuccessful. A fairly close correlation was found to exist, but not close enough to permit the calculation of the one from the other with any accuracy. It, therefore, seemed necessary to prepare tables of frustum form factors for each tree group before making the final

TABLE 4.—*Frustum Form Factors of 424 White Firs (Stanislaus Forest).*

D.b.h.	Height in logs									
	4	5	6	7	8	9	10	11	12	13
18	.85	....	....	....	....	....	....	....	....	....
20	.91	.89	....	....	....	....	....	....	....	....
22	1.04	.96	.87	.88	....	....	....	....	....	....
24	.91	.85	.82	1.08	....	....	....	....	....	....
26	.81	.95	.98	1.08	....	....	....	....	....	....
28	....	.95	.91	1.01	....	....	....	....	....	....
30	....	1.17	.90	.95	.72	....	1.05	....	....	....
32	....	.98	.95	1.09	1.05	.97	....	....	....	....
34	....	....	....	1.04	.96	.89	....	....	....	....
36	....	....	1.15	1.01	.97	1.03	.63	....	....	....
38	....	....	....	....	.90	1.04	....	1.14	....	....
40	....	....	....	1.05	.93	.92	1.03	....	....	....
42	....	....	....	....	.84	1.00	.94	....	....	....
44	....	....	....	....	.79	1.00	.96	.93	....	....
46	....	....	....	....	.92	.91	1.00	1.04	.92	....
48	....	....	....	....	.89	1.04	1.01	.93	....	....
50	....	....	....	....	1.00	.79	.75	.83	.89	....
52	....	....	....	....	....	1.02	.94	.97	.90	1.10
54	....	....	....	....	....	....	.93	.86	.93	....
56	....	....	....	....	....	1.32	1.12	....	....	....
58	....	....	....	....	....	....	.77	.91	....	....
60	....	....	....	....	....	1.06	....	1.01	....	....
62	....	....	....	....	....	....	1.00	....	....	....
66	....	....	....	....	....	....	....	....	.68	....

decision as to how many tables should be prepared and how the localities should be grouped for this purpose.

It has been noted in previous work in other species that frustum form factors varied with diameter only and not with height. Confirmation of this not-entirely proved theorem was therefore sought in the largest group of white fir measurements. Table 4 gives these factors by both height and diameter classes.

The values (uncurved) are, of course, decidedly irregular and there is a large variation within each diameter class, but there seems to be no constant relation between these variations and height. Considering only those diameter classes where there are more than three values, in two the factors appear to increase with an increase in height, in two, to decrease, while in fourteen, they rise and fall irregularly. The hypothesis of the preceding paragraph therefore, seems to be confirmed and the use of a single frustum form factor for each diameter class to be justified.

Table 5 shows the factors thus worked out for each group after increasing the size of the diameter class so as to get more regular figures, but without averaging the results by curves.

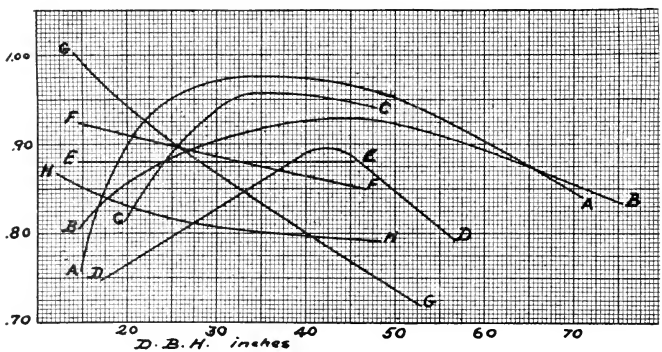

Fig. 1.—Frustum form factors of white fir for different localities. AA—Stanislaus (1); BB—Stanislaus (2); CC—Crocker; DD—Plumas, Tahoe (A); EE—Ellis Meadow; FF—Plumas, Tahoe (B); GG—Deer Camp; HH—Smith Mill.

These values were next evened off by curves, the results appearing in figure 1. The differences in curve form are rather surprising and

TABLE 5.—*Frustum Form Factors for Different Localities.*

D.b.h. class, inches	Stanislaus, Group 1	Stanislaus, Group 2	Crocker	Ellis Meadow	Tahoe and Plumas		Smith Mill	Deer Creek
					Group A	Group B		
18–24	.93	.87	.83	.97	.79	.91	1.00	.96
26–32	.97	.91	.92	.88	.82	.89	.82	.81
34–40	.98	.92	.96	.88	.87	.85	.81	.76
42–48	.97	.93	.95	.88	.91	.90	.80	.79
50–56	.95	.89	...	.84	.80	...	.80	.55
58–64	.90	.91	...	...	...	...	...	.90
Average (weighted)......	.96	.91	.94	.88	.87	.88	.81	.77

the graph at first appears to be but a confused and meaningless tangle, but on closer inspection, it will be seen that there are two rather well defined types of curves, one concave upwards with its maximum at the extreme left, and the other convex upward and with its maximum between 35 and 45 inches d. b. h. Furthermore, it will be found that the former type is common to all groups with low maximum height and the latter to those with high maximum height. The reason for this is obscure. It appears that the curve form may depend on site quality, though the data can hardly be considered adequate in amount to prove this, and the reason therefore is obscure. Possibly the varying age of trees of a given diameter on different sites is the causal factor, but investigation thereof was futile without a large number of additional data.

The following summary was the basis for determining how many tables should be made and how the lines should be drawn between them.

TABLE 6.—*Relation Between Maximum Height and Frustum Form Factor.*

Locality	Number of trees	Average form quotient	Average form factor	Form of curve	Maximum height	
					Total, feet	Merchantable logs
Smith Mill.......	129	.53	.81	Concave	133	6.3
Deer Camp.......	80	.54	.77	Concave	144	7.5
Group C.........	42	.58	.88	Concave	148	7.9
Ellis Meadow....	181	.58	.88	Straight	157	8.2
Group A.........	82	.57	.87	Convex	168	9.1
Crocker	27	.58	.94	Convex	176	10.1
Stanislaus II.....	417	.58	.91	Convex	192	10.3
Stanislaus I......	424	.61	.96	Convex	199	10.7

It was finally decided to make the division indicated in this table, thus defining

Site I as stands in which tallest trees are 10 logs or more high.

Site II as stands in which tallest trees are 8 or 9 logs high.

Site III as stands in which tallest trees are 7 logs or under high.

The group within each site were next combined to yield average frustum form factors, from which curves were drawn.

Table 7 gives the factors read therefrom.

TABLE 7.—*Frustum Form Factors Compared by Sites.*

D.b.h.	Site I	Site II	Site III
10	.779	1.001	1.16
12	.798	.969	1.09
14	.817	.941	1.005
16	.835	.918	.953
18	.853	.899	.885
20	.870	.886	.830
22	.887	.878	.810
24	.902	.875	.802
26	.915	.875	.797
28	.927	.875	.794
30	.936	.875	.790
32	.943	.875	.783
34	.949	.875	.787
36	.952	.875	.785
38	.954	.875	.783
40	.954	.875	.781
42	.952	.875	.779
44	.950	.875	.778
46	.947	.875	.776
48	.942	.875	.774
50	.936	.875	.772
52	.929	.875	.771
54	.922	.875	.769
56	.914	.875	.767
58	.905	.875	.766
60	.896	.875	.763

CHECKS ON NEW TABLES

From these factors, tables were then prepared and checked by the same methods as before. On account of the use of taper curves it was, however, impossible to compute the deviation of each individual tree. A certain number of taper curves were by chance based on but a single tree, and on these the average deviation was computed, the probable error of the rather uncertain result being calculated. This method probably yields conservatively high values, since such taper curves more usually occur for sizes towards the upper or lower limits of the tables, or in other words are based on relatively normal trees. The results are given in Table 8.

It will be seen that the aggregate differences for each of the three tables is under one-half of 1 per cent and may, therefore, be considered satisfactory. It will also be noted that the same figures for individual localities or groups do not exceed about 3 per cent. Theoretically, of course, it would only be by increasing the number of site classes

TABLE 8.

Site	Locality	Number of trees	Scaled volume	Tabular volume	Aggregate difference	Average deviation, per cent	Basis of average deviation, number trees
I	Stanislaus (Group I)..	424	114,871	113,208	+1.47	12.1±1.2	29 or 7%
	Stanislaus (Group II).	417	88,731	89,822	—1.2	12.9±1.6	29 or 7%
	Crocker (Yosemite)...	27	5,717	5,796	—1.36	7.8±1.9	13 of 45%
	Totals..............	868	209,319	208,826	+0.24	11.7±0.9	71 or 8%
II	Ellis Meadow, Sierra..	179	20,425	20,017	+2.04	17.0±2.1	16 or 9%
	Tahoe, Plumas (A)...	82	17 006	17,330	—1.84	13.4±1.6	21 or 26%
	Tahoe, Plumas (B)...	42	5 320	5,226	+1.8	18.1±2.0	11 or 26%
	Totals..............	303	42,751	42,573	+0.42	15.7±0.5	48 or 16%
III	Smith Mill...........	127	9,144	8,898	+2.76	18.6±1.3	11 or 9%
	Deer Camp...........	79	6,613	6,832	—3.21	16.9±2.0	13 or 16%
	Totals..............	206	15,757	15,730	+0.17	17.7±1.2	24 or 12%
	Grand total.........	1,377	267,827	267,129	+0.26	14.0±0.6	143 or 10%

recognized that these local aggregate differences could be reduced to zero. It is felt that the differences from 1 to 3 per cent which appear must be accepted as inevitable in any system of tables which is not prohibitively cumbersome.

The average deviations also will be seen to be materially less than those found in the case of the Forest Service table (Table 1).

It appears, therefore, that the three new tables represent a material gain in accuracy over the old. This gain has been made in three ways:

(A) By working to a fixed top cutting limit.

(B) By employing improved modern technique, the frustum form factor method.

(C) By segregating into three sites.

The desirability of A and B has already been discussed; C, however, is a new expedient, and it is therefore well to try to evaluate the gain resulting therefrom, independent of A and B. It is fair to ask, that is, whether a single table calculated from taper curves, by the frustum form factor method would not have been sufficiently accurate.

Such a table was therefore prepared. It is self-evident that the average site of such a table would be between I and II, since there are relatively few of the data in the lower site classes. It is, therefore, obvious that the table should apply fairly well to these two higher sites, and that the maximum error should occur in using it for Site III; both higher and lower sites should show an error but that in the former should be less marked than the latter.

Two groups only were therefore checked against the table, those forming the highest and lowest site qualities, as these should show the maximum plus and minus error resulting from the single table. The results follow, arranged for ready comparison with those obtained from the same groups and the segregated tables.

The range of error would therefore be increased by the substitution of a single table from 5 per cent to 22 per cent. It would perhaps be possible to modify this single table in such a way as to make it more accurately represent a site intermediate between the highest and lowest, and if so, the maximum error might be reduced from the 18 per cent above indicated to about one-half of 22 per cent or 11 per cent, but this latter figure still appears far too high to be acceptable, and the need for the three tables is therefore established.

TABLE 9.—*Comparative Errors of Site Class and General Tables.*

Group	Number of trees	Aggregate difference from table	
		Separate site class tables	Single table
		Per cent.	*Per cent.*
Deer Camp...........	79	—3.2	—18.1
Stanislaus (I).........	424	+1.5	+ 4.1
Range of error......	....	4.7	22.2

CONCLUSIONS

The foregoing detailed discussion of the work performed shows quite clearly why the division was made on lines of site quality instead of sub-regions. In addition it should be noted that while it would perhaps have been possible to have grouped the data geographically and thereby to have obtained apparently satisfactory tables, the dividing lines between such sub-regions would have necessarily been arbitrarily chosen, and decidedly dubious until a vast number of additional data had been collected. The writer's previous experience furthermore had indicated that other species (notably Idaho white pine) varied in form more with site within even a very small region, than between similar sites which were geographically remote.

The study indicates, therefore, that:

(A) At least for the species in question a single table for a region as large as California is inaccurate.

(B) That separate tables based on site quality (this quality to be determined by the height-index method) are both accurate and practicable.

(C) That if such tables are prepared they will apply accurately to a large region and hence that local tables are unecessary.

DETECTION OF FLAVONE AND THE FLUORESCENCE OF THE WATERY EXTRACT OF WOODS AS AIDS IN IDENTIFICATION

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Director of Forest Experiment Station, Government of Formosa, Japan

Various means of identifying woods are in practice, but only recently has a systematic attempt been made to use for this purpose the detection of flavone and the fluorescence of the water extract. The writer and a few others, notably Prof. Fujioka, have examined these phenomena in a great many kinds of woods and have found them of considerable diagnostic value. The present paper embodies the results of investigations of specimens of North American woods contributed to this station by the U. S. Department of Agriculture and comprising 69 species, 39 genera, and 18 families.

Detection of Flavone.—The occurrence of flavone derivatives in plants is almost exclusively limited to the epidermis and peripheral parenchymatous layer of the aerial parts, with few exceptions on record, in which a considerable amount is also found in the bark and the wood. The writer investigated the American woods by producing anthocyanin solution through reduction of flavone derivatives in wood. The method of reduction is as follows: 5 to 10 cc. of alcohol extract, prepared by heating the wood chips with alcohol, are acidified by an adition of five to ten drops of concentrated hydrochloric acid. A few cc. of the mixture are placed in a test tube with a drop of mercury the size of a pea, and a small amount of metallic magnesium powder. Reduction takes place with a vigorous generation of hydrogen gas whereby the mixture becomes colored and often intensified by leaving over night. The comparative determination of flavone content is rather difficult and therefore only three grades of coloration have been distinguished, namely, strongly colored (♯♯♯), moderately colored (♯♯), and faintly colored (♯).

Fluorescence of the Watery Extract of Wood.—The fluorescence of watery extracts of certain species of plants is a familiar phenomenon. The best known example of the fluorescence of wood extract is the

case of *Pterocarpus indicus*. The method used for detecting fluorescence is as follows: Take a few grams of wood chips and put them into an ordinary test tube with water, leaving them for about two weeks or more, during which time the water usually becomes more or less colored. After sufficient extraction filter off from the chips and examine. If the fluorescence of the extract is very strong it can be

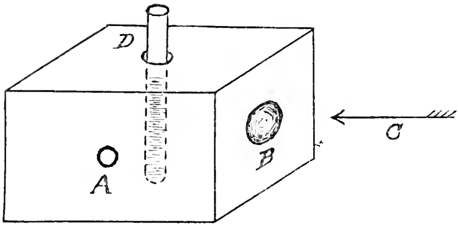

Fig. 1.—Apparatus for detecting fluorescence in water extracts. A, eyehole; B, lens; C, sunlight; D, test tube.

detected even in the open room; if not, special apparatus will be needed. This purpose is served by a small camera box roughly made of wood with an opening in the top to admit the test tube, a small lens in one side, and an eyehole in another at right angles to it as indicated in the figure 1. Place the tube in the camera, let the sunlight coming through the lens fall directly on the extract and observe any fluorescence by placing the eye close to the peephole. The fluorescence is generally intensified by adding ammonia solution, but in some cases it disappears. In the following table (***) indicates pronounced fluorescence evident in the open room, (**) more clearly visible in camera, and (*) detected only by camera.

LITERATURE

(1) K. Shibata, I. Nagai, M. Kishida. The occurrence and physiological significance of flavone derivatives in plants. Biochemical laboratory, Department of Botany, Tokyo Imperial University, 1916.

(2) R. Kanehira. Anatomical characters and identification of Formosan woods with critical remarks from the climatic point of view. Bureau of Productive Industries, Government of Formosa, 1921.

(3) M. Fujioka. Report of Forest Experiment Station, Bureau of Forestry, Department of Agriculture and Commerce, No. 15, 21.

Flavone and Fluorescence in American Woods.

Name of wood	Flavone		Fluorescence		
	Intensity	Color of anthocyanin	Watery extract	Adding amm. sol.	Color of fluorescence
Abies balsamea........	......	......	......	......	......
Abies concolor........	......	......	......	......	......
Abies grandis.........	......	......	......	......	......
Abies lasiocarpa... ...	......	......	......	......	......
Abies nobilis..........	......	......	......	......	......
Acer macrophyllum...	......	......	......	......	......
Acer sacharum........	......	......	......	(*)	Green
Aesculus octandra.....	......	......	......	......	......
Alnus oregona........	......	......	(*)?	(*)?	......
Betula lutea...........	......	......	......	......	......
Betula papyrifera.....	......	......	......	......	......
Castanea dentata......	......	......	......	......	......
Catalpa catalpa........	......	......	......	(**)	Green
Chamaecyparis lawsoniana	......	......	......	(*)?	......
Chamaecyparis nootkatensis.........	......	......	......	(*)	Indigo
Chamaecyparis thyoides	......	......	......	......	......
Cornus florida.........	......	......	......	(*)	Green
Fagus atropunicea.....	......	......	......	......	......
Fraxinus americana...	......	......	......	(**)	......
Fraxinus nigra........	......	......	(*)	(***)	Indigo
Fraxinus oregona.....	......	......	......	(**)	Indigo
Gleditschia triacanthos.	(###)	Orange red	(*)	(***)	Indigo
Gymnocladus dioicus...	(##)	Orange red	......	(**)	Green
Hicoria alba..........	......	......	......	......	......
Juglans cinerea........	......	......	......	......	......
Juglans nigra.........	......	......	......	......	......
Juniperus virginiana...	......	......	(**)	(***)	Indigo
Larix laricina.........	(#)	Magenta	......	......	......
Larix occidentalis.....	(###)	Magenta	......	......	......
Libocedrus decurrens..	......	......	......	......	......
Liquidambar styraciflura..........	......	......	(*)	......	Green
Liriodendron tulipifera	......	......	......	......	......
Magnolia acuminata...	......	......	......	(*)	Indigo
Mohrodendron carolinum...........	......	......	(*)	(*)	Indigo
Nyssa biflora.........	......	......	......	......	......
Nyssa aquatica........	......	......	......	......	......
Picea engelmanni......	......	......	......	......	......
Picea sitchensis.......	......	......	......	......	......
Pinus contorta........	......	......	......	......	......
Pinus echinata.........	......	......	......	......	......
Pinus monticola.......	......	......	......	......	......
Pinus palustris........	......	......	......	......	......
Pinus ponderosa.......	......	......	......	......	......
Pinus resinosa.........	......	......	......	......	......
Pinus strobus.........	......	......	......	......	......

Name of wood	Flavone		Fluorescence		
	Intensity	Color of anthocyanin	Watery extract	Adding amm. sol.	Color of fluorescence
Pinus taeda...........	......	......	......	......	......
Platanas occidentalis...	......	......	......	......	......
Populus deltoides......	......	......	......	(*)	Indigo
Populus tremuloides...	......	......	......	......	......
Populus trichocarpa...	......	......	......	......	......
Prunus serotina........	(###)	Magenta	......	(**)	Green
Pseudotsuga taxifolia..	(###)	Magenta	......	......	......
Quercus alba..........	......	......	(*)	(*)	Green
Quercus densiflora.....	......	......	......	(*)	Green
Quercus garryana.....	......	......	......	(*)	Green
Quercus prinus........	......	......	......	(**)	Green
Quercus rubra........	......	......	......	(*)	Green
Robinia pseudoacacia..	(###)	Violet red	(*)	(**)	Green
Sassafras sassafras....	......	......	......	......	......
Sequoia sempervirens..	......	......	......	......	......
Sequoia washingtoniana	......	......	......	......	......
Swietenia mahagoni....	......	......	(*)	(**)	Green
Taxodium distichum...	......	......	......	......	......
Tilia americana.......	......	......	(**)	(**)	Indigo
Thuja occidentalis.....	......	......	......	......	......
Thuja plicata.........	......	......	......	(*)	Indigo
Tsuga canadensis	......	......	......	......	......
Tsuga hetrophylla.....	......	......	......	......	......
Ulmus americana......	......	......	......	(**)	Indigo

THE EFFECT OF SPIRAL GRAIN ON THE STRENGTH OF WOOD

By Thomas R. C. Wilson,

Engineer in Forest Products, Forest Products Laboratory

The occurrence of spiral or cork-screw grained trees has long been a subject of interest to foresters. Many theories have been advanced to account for the phenomenon and experiments are now under way to determine if it is inheritable.

Severe spiral grain has been recognized by many as disqualifying timber for uses in which strength and resistance to shock are important. However, many timber producers and users, while recognizing as defects knots, pitch pockets, rot, shakes, severe checks, and cross grain resulting from mismanufacture, have entirely neglected spiral grain as a source of danger or weakness except perhaps in extreme cases.

It has long been observed in the testing laboratory that spiral grain is as weakening as other forms of cross grain and it has been considered more dangerous because of the probability of its passing unnoticed or not being recognized as a source of weakness. It had not been possible previous to the war to carry out tests to give a quantitative measure of the effect of spiral or other forms of cross grain, but when the problem of specifying material for use in airplane construction arose, it soon became apparent that more exact knowledge of the effect of deviations of the grain of wood from parallelism with the edges or axis of the piece was needed. In order to secure such information a series of tests was made on Sitka spruce, Douglas fir, and white ash, at the Forest Products Laboratory. These tests go a long way in clarifying cross grain and spiral grain as defects and, because of the depreciating influence of these defects upon the strength properties of the wood and the frequency with which spiral grain occurs in many stands, indicate that their control is a subject worthy of study by the silviculturists.

Before proceeding to further discussion of these tests, it is desirable to have exact definitions of some of the factors to be treated.

The term "cross grain" covers all instances in which the direction of the wood fibers deviates from straightness or is not parallel to the axis of the piece. Considering the fact that the trunk of a tree is made

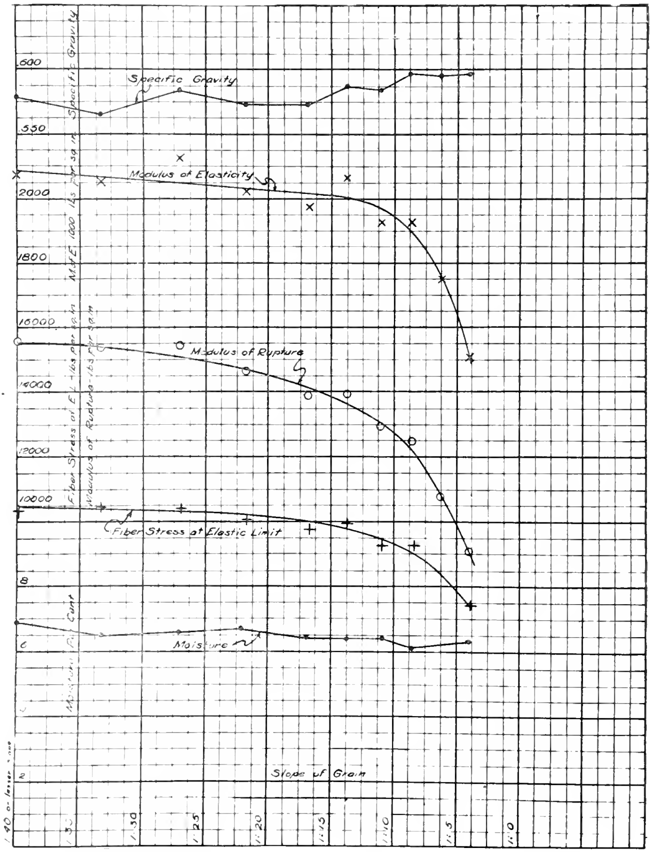

Fig. 1.—Effect of spiral and diagonal grain on fiber stress at elastic limit, modulus of rupture, and modulus of elasticity in static bending. White ash.

up of wood fibers arranged in annual layers it is evident that there are two principal ways in which cross grain may occur.

(*a*) The annual layers may not be parallel to the axis of the piece. This results in *diagonal grain*. Diagonal grain is most readily determined by inspection on quarter-sawed surfaces, that is, surfaces which are radial to the direction of the annual growth rings.

(*b*) The wood fibers instead of being vertical in the tree may wind around it in a cork-screw curve or spiral. This is *natural spiral grain*. If a piece from a tree which is free from natural spiral grain is cut in such a manner that the wood fibers as observed on a flat-sawed face are not parallel to the axis of the piece a phenomenon somewhat similar to natural spiral grain is produced and the piece may be said to be *artificially spiral-grained*.

In order to correlate cross grain in timber with its strength properties, it is necessary to have some measure of the cross grain. This is furnished by the angle between the direction of the fibers and the edge of the piece. This angle is usually expressed as a *slope*, for instance 1 *in* 15, or 1 *to* 15, means that in a distance of 15 inches the grain deviates 1 inch from the edge of the piece.

Because of the difficulty of getting comparable material with *natural spiral grain* of various slopes, tests were made on sticks containing *artificial spiral grain*. The standard size of stick for these tests was 2 by 2 by 48 inches. Sticks from each plank were made straight-grained and with various slopes of spiral or diagonal grain. This provided specimens which were inherently similar except for the different slopes of grain. Approximately one-half of the sticks of each slope of grain were tested in static bending and the remainder in impact bending. Following the bending tests a piece for test in compression parallel to grain was cut from each stick of ash whenever sufficient uninjured material remained. Tests were made on about 1,800 sticks of Sitka spruce, 900 of Douglas fir, and about 1,800 of commercial white ash.[1]

Sticks were cut with as near as possible predetermined slopes of grain but in order to avoid mistakes in slope classification all sticks were examined after test and the slopes of both diagonal and spiral grain at the point of failure determined. When a piece had both

[1] This material is termed commercial white ash because although the exact species were not known it was all from species classified in the market as white ash.

spiral and diagonal grain the two slopes were combined to get the true or absolute slope of grain. As spiral grain appears in the tangential plane or surface and diagonal grain in the radial plane the absolute or combined slope is computed by taking the square root of the sum of the squares of the slopes of spiral and diagonal grain. As a specific example

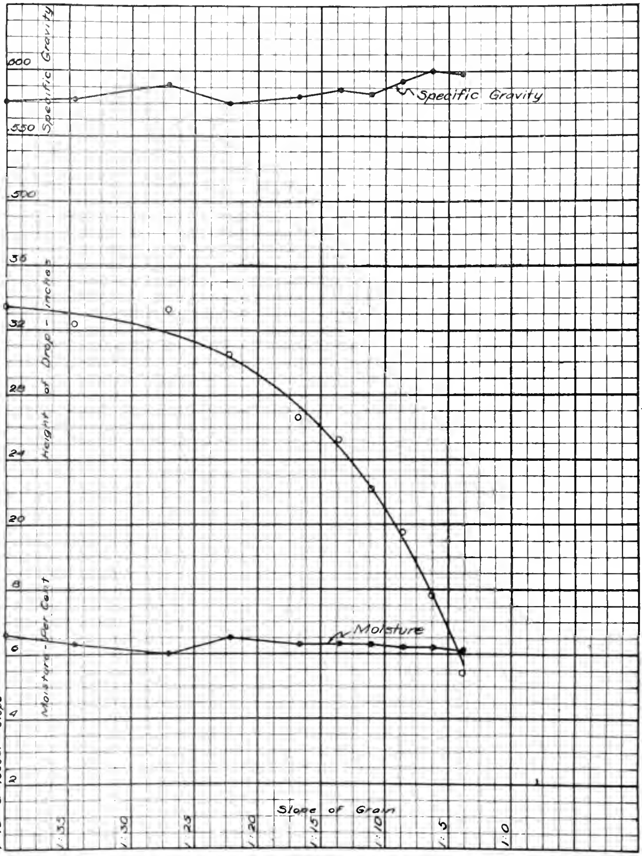

Fig. 2.—Effect of spiral and diagonal grain on maximum drop. White ash.

of this computation assume a test piece has slopes of 1 to 10 and 1 to 15. For computation of absolute slope these ratios are converted into decimals and are equivalent to .10 and .067, respectively. Squaring these and extracting the square root, gives .12 which expressed as a ratio equals 1 to 8.3.

In correlating the data, all the sticks with slopes of grain between certain limits as 1 to 30 and 1 to 39.9, 1 to 25 and 1 to 29.9, 1 to 20 and 1 to 24.9, etc., were averaged together with respect to strength properties and slopes. All sticks with slopes not greater than 1 to 40 were averaged together and treated as if they were straight-grained.

The average values of strength property and slope were plotted in diagrams such as figures 1, 2, and 3, in which specific gravity and moisture content were also plotted. These figures were for white ash only but the curves showing the relation of strength properties to slope of grain are not essentially different for the other species.

Figure 4 presents a comparison of the three species with respect to the influence of slope of grain on a combination of important strength properties. The maximum difference between the three curves does not exceed 3 per cent until a slope in excess of 1 to 12.5 is reached, thus indicating that in the aggregate the three species are practically alike with respect to the relation of slope of grain to strength properties.

Table 1 shows the percentage by which material with the various slopes of grain falls below straight-grained material in various strength properties.

Inspection of the figures and table shows that compressive strength is but little affected until quite steep slopes of grain (1 to 10 or greater) is reached. Modulus of elasticity—stiffness—is more affected and begins to suffer a really appreciable decrease at a slope of 1 to 15. Modulus of rupture—strength in bending—decreases even more rapidly and has about 10 per cent deficiency at a 1 to 20 slope and nearly 20 per cent at 1 to 15. The most pronounced effect is on work to maximum load and maximum drop—both measures of shock-resisting ability—which are considerably deficient even at a slope of 1 to 25 and decrease very rapidly as slope of grain increases.

As a result of these tests, it has been recommended to the War and Navy Departments and to aircraft manufacturers that slopes of grain in excess of 1 to 20 should not be permitted in highly stressed parts. The advisability of restricting the slope of grain to 1 in 20 as now provided in grading rules for select structural southern yellow pine and Nos. 1 and 2 structural Douglas fir is confirmed by the tests.

In view of the showing of these tests and of the fact that in so many of the uses of timber strength and shock resistance are of great importance, it is apparent that the exercise of considerable effort to discover and overcome if possible the causes of spiral grain in tree

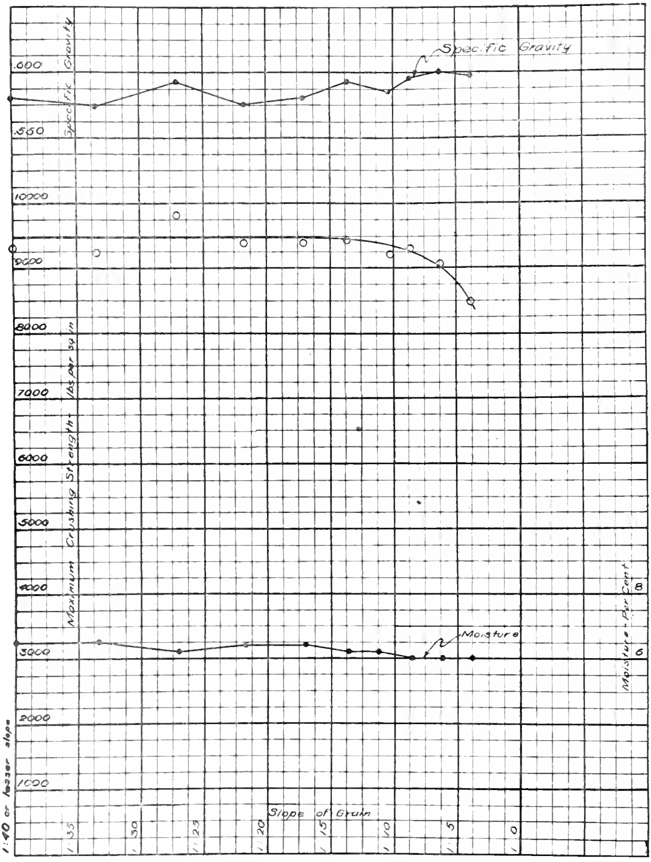

Fig. 3.—Effect of spiral and diagonal grain on maximum crushing strength. White ash.

growth is justified. It has been observed that in some stands and some localities, the presence of spiral grain is so large that stumpage values are heavily depreciated. The production of trees with straight trunks free from irregular and spiral grain will reflect to the credit of American silviculture by contributing very materially to the financial stability of the rotation and by promoting economy in forest production.

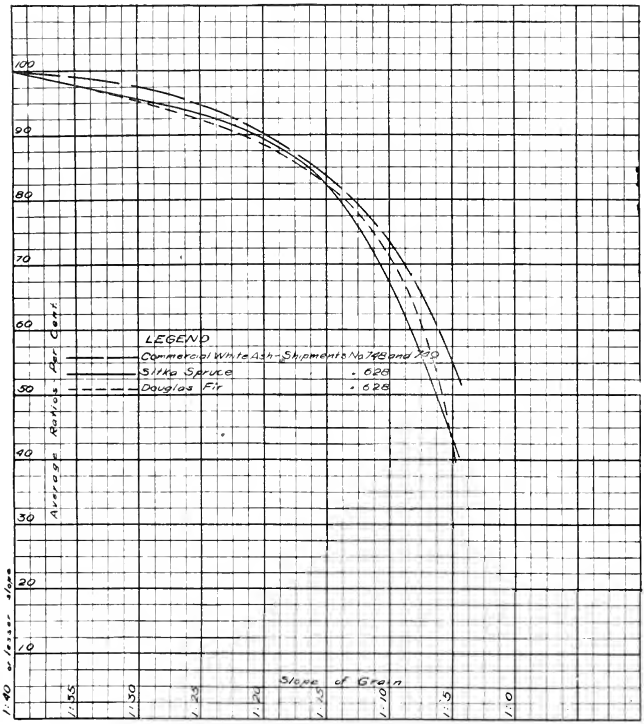

Fig. 4.—Composite curves showing the effect of spiral and diagonal grain on modulus of rupture, modulus of elasticity, work to maximum load, and maximum drop. White ash, Sitka spruce, and Douglas fir.

TABLE 1.—*Average Percentage Deficiency in Strength Properties of Spiral and Diagonal Grained Material of Various Slopes with Respect to Straight-Grained Material.*

Slope of grain	Static bending			Impact bending	Compression parallel to grain
	Modulus of rupture	Modulus of elasticity	Work to maximum load	Maximum drop	Maximum crushing strength
White ash—					
1:25	4	2	9	6	0
1:20	6	3	17	12	0
1:15	11	4	27	22	0
1:10	18	7	43	37	1
1:5	36	22	61	59	7
Sitka spruce—					
1:25	2	2	14	8	..
1:20	4	4	21	13	..
1:15	8	7	33	22	..
1:10	17	13	55	45	..
1:5	44	36	76	69	..
Douglas fir—					
1:25	7	4	17	1	..
1:20	10	6	24	4	..
1:15	15	8	34	13	..
1:10	25	14	46	31	..
1:5	54	40	68	65	..
Average for three species—					
1:25	4	3	13	5	..
1:20	7	4	21	10	..
1:15	11	6	31	19	..
1:10	19	11	48	38	..
1:5	45	33	68	64	..

A NATIONAL POLICY FOR FORESTERS

By Russell Watson

Assistant Professor of Forestry, University of Michigan

"It is fear, little brother, it is fear."

"He either fears his fate too much
Or his deserts are small,
And dares not put it to the touch
To win or lose it all."

Most foresters do not thoroughly believe in forestry—to hear them talk. Reports and articles of foresters, and the trend of discussions regarding national policies of forestry show this. They do not believe, apparently, that timber is a commodity that is vitally needed in our American civilization. They do not believe that an adequate supply of timber is necessary if we are to retain our position in the front rank of the world's nations. It is not realized that it takes much land and a real growing stock of trees to produce this commodity in the amounts required.

It is certain that most foresters do not believe that forestry should be practiced as a business in the United States. In Europe, it is admitted, forestry is recognized as a business, but not so here, and not for many years to come.

Pessimism is in order. It is considered "practical" to be pessimistic over the success of timber growing. No trees can be planted, it is felt, without serious risk of losing them through insect and fungus attacks, and therefore it is doubtful if we ought to plant trees at all. One forester who has been stung severely by the white pine tip weevil in his plantations is now in such a state of hysteria that, it is said, he even doubts that he doubts. Fires run over forests, and some good foresters have actually thought seriously of abandoning a million acres of excellent timber growing land because of the fire hazards. White pine blister rust and chestnut blight are rampant, and no known means of control. It is felt by many that since these two trees are doomed that any trees may be, and that all should be abandoned. The destruction of the forests by the lumbermen is deplored. Yet this is taken as a matter of course, as an act of God, just as many people in northern Minnesota consider the forest fires of that region.

As foresters we lack the courage of our convictions. We all studied the evidence of statistics a year or two ago and found out that this nation is in a bad fix for timber. We know that in 50 years or so a severe timber shortage will hit the country. We know further that nothing under heaven can stop it. Yet we advocate a policy of "puttering." We hide our heads in the sands of the lands given to us for forestry and try to delude ourselves into believing that we can grow saw-log material in 50 years. We will not admit that which we know to be true. We forget that where we have one acre of soil so good that log material will develop in 50 years, that we have 25 acres of land where it takes a hundred or more years to grow 15-inch stuff. We like to figure on trees that can be grown in a jiffy, like the East Indian magician flips a cherry tree into the air with a colored boy picking fruit from the branches to the delight of the villagers clustering around.

We put forth baits in the shape of good returns on forest investments. We try to excuse our existence as foresters by guaranteeing net returns from the National Forests.

We will not reckon on the fact that the growth to replace our destroyed forests has not even started as yet. We refuse to believe, apparently, that even with the most energetic beginnings and sustained efforts, that we cannot possibly, within a hundred years, grow as much timber per year as we will use or will wish to use.

We plead with the agronomist for a little "absolute" forest land. We make soil classifications to see if possibly we cannot scrape together a few acres for forestry. The benefit of the doubt is always given to somebody other than to the forester. We give it to the land "shark," the "boomer," the "come-hither-and-prosper" artist. The forester tacitly admits that the leavings, the dregs, is all the land that he is entitled to have for his forests.

To inhibit a national shortage of timber we ask only for more efficient utilization, for low stumps, for the practice of a little silviculture in the woods. We plead with the timberland owners to employ a forester or two, and to save a few seedlings when logging. This attitude is precisely akin to a people under an autocracy begging the ruler not to starve them to death.

Our Forest Service enlists us all to obtain some data on the minimum silvicultural requirements needed to perpetuate our forests. What we were obtaining data on in reality, and trying to find out, was not minimum silvicultural requirements, but rather that maximum forest devastation which could be practiced conveniently and still be

misnamed forestry. The idea of that study seems to be about this: get some reproduction if possible, but under no circumstances disturb the slash-bang, engine of destruction, cheap-logging, vast-area-devastation methods of the logger. The speed of the overhead skidder, it would seem, should not be hindered by forestry.

Foresters are afraid of forestry. Listen to what they say! "Of course, sustained annual yield can only be considered for the very distant future." "Wait until lumber prices get higher, then we can do something." A third says, "If such a plan were proposed to the legislatures, it would make us all appear ridiculous," despite the fact that the plan proposed simply asks for the practice of forestry in the forests. These quotations are straws flying with the winds of foresters' opinions.

Such remarks from teachers of forestry, and especially from those foresters who are in the field and ought to know better, do not help the cause of forestry. We gain nothing by appearing wise and practical and stating solemnly that forestry cannot compete with good 7 per cent bonds, and therefore no use to try to force forestry on the private timber owners. To state it thus is to beg the question. It is not for us, as foresters, to guarantee that forestry will pay; we need only to guarantee that without forestry the nation will suffer seriously. Our task is to raise timber.

We, as foresters, should know, and should preach, that the very best forestry that can be practiced is none too good. We should tell people that we never, probably, will have too much land in timber. We should realize, thoroughly, that under the conditions of forest destruction at hand over the country, we cannot hope to obtain adequate supplies of timber for the future by any two-penny ha-penny methods.

After all, aren't we running before a bugaboo of nothing? Aren't our forestry fears psychological rather than real? The nation does not consider stopping raising wheat because many fields are seriously smutted. Corn is not abandoned as a crop because of the corn borer, nor yet because it brings this year only 45 cents. We do not discontinue the growing of cotton because of the attacks of boll weevils. We need timber as badly as we need cotton; and a tip weevil which is abundant, or a blister rust which is everywhere, should not cause us to abandon forestry—it should simply spur us on to greater efforts.

Let us hitch our wagon to the star of our ideals. They are very real, and their practice is exceedingly necessary in our national prosperity. Let us get out of the state of mind in which we beg the lumberman to

leave a tree or two per acre for seed. We want our forests so handled that we will obtain from them a sustained annual yield. Let us not give forth figures of 10 cents per acre as the cost of forestry, but tell the people that if forestry is to practiced that we will need a dollar an acre per year for 25 years, and, further, that there will be little or no income in that time. If the nation decrees that this is too much to spend—well, it can't be helped. The nation is in a hole for timber, and to climb out requires a great and costly effort. What if we are called impractical dreamers? Fernow and Roth and Sargent and others were called "denudatics" a few years ago, and were scolded by the press for telling the truth as they saw it. Now everybody knows that they spoke with wisdom. Let us, too, have the courage of our convictions as we see them. We at least can follow our ideals.

It is not for us to argue as to whether or not a certain "forty" might perhaps be used to grow pine instead of squirrel-proof hazelnuts. With us it is simply an open-and-shut case of needing enough land to supply the nation with timber.

We should not quarrel with the lumbermen over the practice of forestry; let them quarrel with us if there is any quarreling to be done. To argue the point is to admit that there is an argument. But from the forester's point of view there is no argument—the facts are too certain.

It is not for us to question whether or not forestry pays. We know that the nation needs timber, and must have it, whether the crop pays 7 per cent or 2 per cent of no per cent on the investment. England has just discovered this. Continental Europe has known for a century that it does not pay to be without timber. Now we are fast learning, and the experiences which teach us our lessons will be more costly each year. Just recently a farmer in southern Michigan was offered $2,500 for the ten white oak trees that the timber buyer could see from where he stood. At that rate, it were better for the nation to invest in forests and have no returns, for if it does not some other will, and they will demand not 7 per cent but probably very much more on their investments.

As citizens and users of lumber it is our task to call to the attention of folks the calamitous position we are in for wood supplies, and we should urge upon our legislators the need for direct-action legislation.

As foresters, however, our attitude toward the public should be that of the man who knows what should be done and who is willing to do it if called upon. We never should admit that mere talk and forest devastation with promises are going to raise timber. Good forestry—and the very best is none too good—great efforts started immediately and continued for a century or more—that is the policy for foresters of the United States.

SOME OBSERVATIONS ON THE RELATION OF SOIL MOISTURE TO HEIGHT GROWTH IN YELLOW PINE SAPLINGS

By Walter J. Perry

It is interesting to note how the wetness or dryness of a season is directly reflected in the height growth of pine saplings. Knowing the precipitation figures for any one of recent years, the figures for any one of the remainder could almost be set down simply by observing the annual growth of the young trees for the corresponding year.

The figures given herewith, covering a dozen years, are the result of recent observations and measurements along this line, and supplement and confirm my general observations for many years. The most remarkable thing they show is that the growth for 1920 is some 112 per cent greater than the average for the previous 11 years. It is also notable that no evidence is to be found of any year's growth during the past 40 or 50 years, or indeed at all, even approaching that of 1920. This enormous growth is, without doubt, to be credited to the heavy snows of the winters of 1918, 1919, and 1920, and the rains which continued through the summer of 1920. Many springs and arroyos, which ordinarily would have been dry, were flowing that year.

Trees selected for measurement ranged from 20 to 32 years of age, with an average of 27 years. Total heights ranged from 8 feet 7 inches to 16 feet 5 inches, with an average of 12 feet 3 inches.

Special care was taken in selecting trees, with reference to having all types of density of stand represented, from open-grown, isolated specimens to badly crowded ones, the object being a study on rate of perpendicular and lateral growth under varying conditions.

Observations were made in pure yellow pine type at an elevation of approximately 7,200 feet. The type site is fair to excellent; timber is a rather sparse stand of mature and overmature 2-3-log trees with an occasional 4-log tree; there is an understory of 8-14-inch black jack and saplings 20 to 30 years old, the latter being principally in groups surrounding old trees; younger seedlings are infrequent, and the site may be considered fully stocked as it stands.

The result of the observations showed that: (1) Yellow pine is making its most rapid upward growth at about the age of 30 years, at which age it has reached a diameter of 4 inches or slightly more under reasonably close spacing. (2) Moderately close spacing of seedlings is required to force this desirable upward growth. (3) Even extreme crowding in early youth is preferable to too open spacing, as the crowded condition tends to upward growth, and eventually regulates itself. (4) Where reproduction is lacking, provision should be made at time of cutting for abundant reseeding.

Year	Average age, years	Average height, feet	Minimum growth in height, inches	Maximum growth in height, inches	Average growth in height, inches
1909	16	4.4	4	10.0	6.75
1910	17	4.9	3.5	8.0	5.25
1911	18	5.2	2.5	6.5	5.00
1912	19	5.8	5.0	8.5	6.50
1913	20	6.3	4.0	10.0	6.25
1914	21	6.9	3.5	9.0	6.50
1915	22	7.5	5.0	17.0	8.00
1916	23	8.3	6.0	13.0	9.87
1917	24	9.0	6.0	11.0	9.25
1918	25	9.7	4.0	12.0	7.01
1919	26	10.4	4.5	12.0	9.25
1920	27	12.3	9.0	25.0	19.00

ONE CORD AN ACRE A YEAR

By Willis M. Baker

Assistant State Forester of New Jersey

Intensive forestry methods are rapidly becoming practicable in New Jersey. A considerable portion of the forested area of two million acres consists of farm woodlots, usually with soils of fair fertility capable of producing valuable timber crops, but either too steep, rocky, or wet for agriculture. Many farmers have spare time and idle help at certain seasons that could be profitably employed in woods work, and it is gratifying to note that a constantly increasing number of them are realizing that such work is worth while.

Excellent markets for all kinds of wood products are located within the State and at its borders; the railroad, electric, water, and highway transportation facilities are unexcelled anywhere. For several years the extensive cutting of blighted chestnut has tended to glut the market at times with certain products, but with the decline of his salvage-cutting and a steadily decreasing supply of other merchantable stumpage, it is constantly becoming more difficult to satisfy the increasing demand for most kinds of wood. Good nearby markets for such products as ties, mine timbers, poles, piling, boat fenders, box boards, basket stock, posts, dunnage wood, cordwood, etc., make close utilization possible and practicable.

The manner in which woodland owners have accepted forestry methods and are putting them to practice, especially during the last two years, is decidedly encouraging. It is felt that actual demonstrations of woodland under forestry management—both privately owned tracts and State forests—have contributed considerably to whatever success has been met in this work. When a tract of woodland along a public highway has received proper treatment, or an idle field has been put to work growing trees, a sign is erected to inform the public why the work was necessary, and what results and benefits will be secured.

Facts and observations regarding some of these demonstrations are of interest.

Thinning 20-year-old Second-growth Oak on the South Jersey Sands.

In many sections of the South Jersey sand region second-growth oak has taken complete possession of the land formerly occupied chiefly

by pine. It is a common local practice to clear-cut such stands of young oak for cordwood when from 15 to 25 years of age, after which another dense stand immediately takes its place, largely from sprout reproduction. The trees are generally so crowded that growth is very slow, particularly after the first 10 or 15 years.

To determine the possible rate of growth of oak in this sand region, a typical 20-year-old, crowded stand was selected on the Lebanon State Forest in Burlington County. In the winter of 1911-12 two similar 1-acre plots were carefully laid out and measured; one (*A*) was thinned of crowding and suppressed trees, while the other (*B*) was left to serve as a check plot. The cost of the thinning was more than paid for by the sale of the wood. In the spring of 1919, after seven season's growth, both plots were again measured to determine results, which are tabulated in Table 1.

TABLE 1.

	Acre Plot—A (thinned)				Acre Plot—B (check)	
	1912			1919	1912	1919
	Stand before thinning	Removed in thinning	Left after thinning			
No. of trees 2 inches d. b. h. and over....	731	268	463	458 (5 dead)	555	558 (26 dead)
Range in diameter in inches	2–5	2–4	2–5	2–7	2–6	2–7
Average diameter in inches	2.8	2.3	3.2	4.3	3.4	3.6
Volume, cubic feet...	438	81	357	802	618	690
Total gain in cubic feet, 1919..........	....	....	....	445	....	72
Gain in cubic feet per year	....	....	....	63.6	....	10.3

By actual measurement it has been demonstrated that a cord of piled wood of this size (trees from 2″–6″ D. B. H.) contains about 65 cubic feet, as calculated from the volume table on page 121, Woodsman's Handbook, instead of the converting factor generally used of 80 cubic feet = 1 cord.

These figures in Table 1 show that the thinned acre (*A*) increased from 5.5 cords in 1912 to 12.3 cords in 1919, or a gain of practically one cord per acre per year, whereas the check acre (*B*) only increased from 9.5 cords in 1912 to 10.6 cords in 1919, or a gain of 1.1 cords

in *seven* years. These results are regarded as especially significant because oak is naturally rather slow in growth, and because the South Jersey sands, while capable of producing good timber, are not considered as most favorable for tree growth.

Improvement Cutting in a Stand of 20-year-old Mixed Hardwoods.

Fifty years ago a 20-acre tract of hardwood timber at Mount Laurel, Burlington County, now the Mount Laurel State Forest, was clear cut, and another stand of timber of both sprout and seedling origin took its place. The principal species in the order of their abundance were chestnut oak, red oak, white oak, black oak, chestnut, hickory, red maple, red gum, and black locust. There was also considerable scrub and pitch pine on certain areas, records of which are not considered in this report.

At 40 years of age (1911) this tract contained trees from 3 to 16 inches in diameter with a total volume of 2,259 cubic feet, or approximately 28 cords per acre. An improvement cutting made at this time removed all chestnut, toegther with crowding, inferior, and suppressed trees of other species, which were sold as sawlogs, telephone poles, fence posts, bean poles, vineyard stakes, and cordwood. Forty-five per cent of the volume of the stand was cut and sold at a net profit of $15 [1] per acre, leaving a stand of 142 trees per acre from 3 to 16 inches in diameter and an average diameter 7.2 inches, with a total volume of 1,232 cubic feet or approximately 15.4 cords per acre. After 10 years' growth (1921) there were found to be an average of 172 trees per acre from 3 to 19 inches in diameter and an average diameter of 9.1 inches, with a total volume of 1,980 cubic feet or approximately 24.8 cords, or a gain of 9.4 cords per acre in 10 years. Again we have practically a cord per acre per year following an improvement cutting. These results are particularly encouraging because the stand was composed largely of rather slow-growing oaks; stump analyses in 1911 showed that the entire stand had been crowded and growth retarded for a period of 20 years before the improvement cutting was made; with an average of only 142 trees per acre after the improvement cutting the stand was not fully stocked. Had fully stocked areas containing from 200 to 250 trees per acre been isolated and measured, an increase of more than a cord per acre per year would have been observed.

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[1] A similar improvement cutting in a 90-acre woodlot in Morris County yielded a net profit of $45 per acre.

Example of Growth Retarded by Crowding.

Other experiments and demonstrations of improvement cutting have been made during 1921 on the Stokes State Forest in Sussex County, and on the lands of the East Orange Water Reserve in Essex County. Although only the preliminary cutting and growth measurements have been made, the latter demonstration affords an excellent example of what happens when thinnings and improvement cuttings are not made in time.

Two tracts of mixed hardwoods growing side by side on a rich, moist, gravelly, clay-loam soil, too rocky for agriculture, were selected. Both were comparatively even-aged stands, except as reproduction of tolerant species—maple, beech, etc., had come in from time to time. Both tracts grew from sprout and seedling reproduction following clear cutting, but with this difference, one tract was 25 years old and the other 50. The principal species in the order of their abundance were white oak, red maple, black oak, and red oak, with some hickory, beech, ash, black gum, sassafras, blue beech, and dogwood. As far as can be learned both tracts have grown under similar conditions, the only difference being that of age.

The 25-year old stand contained 826 trees per acre from 2 to 8 inches in diameter with an average diameter of 3.7 inches and a total volume of 1,423 cubic feet, or 17.8 cords per acre. The 50-year-old stand contained 630 trees per acre from 2 to 10 inches in diameter with an average diameter of 4 inches, and a total volume of 1,635 cubic feet, or 20.4 cords per acre. The trees on both tracts showed a marked slowing up of growth at about 20 years of age, which means that the 25-year-old stand is just beginning to show the retarding effects of crowding, whereas the 50-year-old trees have grown slowly for the last 30 years; in the 50-year-old stand there are approximately 200 trees per acre less than in the 25-year-old stand, the average diameter is only 0.3 inch larger, and the volume of wood only 2.6 cords per acre greater. Assuming that the 50-year-old tract at 25 years of age was identical with the present 25-year-old tract adjoining, as seems justifiable, then it has increased in volume at the rate of 0.1 cord per acre per year for the past 25 years. This figure checks closely with the growth observed in the crowded check plot described above on the Lebanon State Forest, after 7 years of growth.

Following these preliminary measurements and observations, thinnings were made in both tracts with check plots left for control. In

a few years it will be possible to make further interesting observations.

Nineteen Thousand Board Feet per Acre from Norway Spruce in 34 Years.

Although considerable forest planting has been done in New Jersey, nearly all of the plantations are still less than 20 years of age, and therefore too young to provide an estimate of yield. There is, however, a plantation of Norway spruce, mixed with a few trees of Scotch pine, hemlock, arborvitæ, and tulip (a rather complicated mixture), on deep rich bottomland in Warren County, that has grown 19,000 board feet of sawlogs per acre at 34 years of age, or 560 board feet per year. The trees were spaced 8 feet apart and the stand is now too open because the spruce and hemlock have shaded out the less tolerant pines and tulips. There are now 318 trees per acre, ranging in diameter from 5 to 18 inches, with an average diameter of 9 inches. Had the plantation been spaced 6 feet by 6 feet, and thinned at about 20 to 25 years, no doubt a greater yield would have resulted. It is only fair to say that it was intended for a game cover, and was planted on agricultural land where optimum growth was to be expected.

It is realized that more cuttings under various conditions, and longer periods of observations are needed to establish definite and accurate growth figures, but we nevertheless believe that the examples cited in this article are conclusive enough to permit us to adopt the slogan, "One cord an acre a year." When New Jersey's "true forest soils," of which we have nearly 2 million acres, are growing at half that rate, we will not have to depend upon an imported supply of wood.

THINNINGS IN LOBLOLLY PINE AT A PROFIT

By J. A. Cope

Assistant Forester of Maryland

In a previous article [1] reference was made to a cutting and splitting machine which functioned so effectively in the conversion of inferior hardwoods and small pines to merchantable cordwood, that the lumber man was able to clean up his cutover loblolly pine land at an actual profit. After having the practicability of this machine demonstrated to the writer so conclusively, the thought naturally occurred why would it not be equally practical to employ it in rendering merchantable the thinnings from a growing stand of pine?

Fortunately there was close at hand a vigorous young loblolly pine thicket, several acres in extent, and the lumberman was very willing to co-operate in having a demonstration thinning made on a sample acre.

This stand had come up on an abandoned field, the seed blowing in from adjacent old timber. The soil was a sassafras sandy loam, which is a pretty good indication of Quality I site for loblolly pine on the Eastern Shore of Maryland. At the time of making the thinning, the thicket contained 1,810 trees to the acres, counting those trees 2 inches d. b. h. and over. The heights for the three crown classes were obtained by actual taping, with the result that dominants fell in the 40-foot height class, intermediates fell in the 30-foot height class, overtopped fell in the 20-foot height class. Using cordwood volume tables made especially for Maryland loblolly pine, these 1,810 trees gave a yield of 26.5 cords.

A careful ring count of trees in all crown classes established the age of the stand as 14 years. Certainly this is a very excellent showing, and compares favorably with the best yields of Quality I sites for loblolly pine in North Carolina.[2]

In making the thinning, an effort was made to give the dominants growing space without at the same time opening up the forest floor to the light. This resulted in the marking of all overtopped, about 70

[1] Journal of Forestry for April, 1921, pages 399-401.

[2] Loblolly Pine, by W. W. Ashe, page 89, table 35.

per cent of the intermediates, and some few dominants, so that for all practical purposes it may be termed a C-grade thinning.

In all 792 trees were marked on the acre. These were immediately felled by a cutting crew, and the poles stacked in convenient piles for subsequent delivery to the cutting and splitting machine which had been set up close by. The thought may suggest itself to the reader that an ordinary circular saw should be sufficient for use with sticks of such small diameter, and that the added expense of splitting could be omitted. There is, however, no sale for pine as fuel wood unless thoroughly dry. In the round, this drying out process is very slow and unsatisfactory, and if the wood is cut in the spring, as in the present instance, the cambium at once becomes infested with larva and the pine sawyer. A simple halving of the sticks not only hastens the seasoning, but so quickly dries the cambium that the pine sawyers do not attack it at all.

After running the poles through the cutting and splitting machine, the wood was carefully ranked up and measured. The total yield from this thinning was thus found to be 11 cords. (These cords were slightly under normal size, since 3 ranks of 15 inch sticks makes 45 instead of 48 inches.)

A tabulation of the trees left standing is as follows

D.b.h.	Dominants	Intermediates
2	9	63
3	140	142
4	362	42
5	91	11
6	57	3
7	23	...
8	11	...
9	2	...
10	1	...
Total	796	261
Grand total		1,057

which by cordwood volume tables equals 15.5 cords.

This table shows that there are still over a thousand trees to the acre standing on the plot. On the best quality sites for loblolly pine in Maryland, fully stocked natural stands will not contain more than 375 trees to the acres at financial maturity, that is, 35-40 years. The way has thus been left for successive thinnings at 5-year intervals, thinnings which will at the same time stimulate the growth of those trees that are to remain to the end of the rotation.

There is, of course, no question of the advantage to the growing timber, of such a thinning; but the land owner must be convinced that he can at least break even on such operations before he will become interested. Furthermore, it is the policy of the State Board of Forestry to encourage such thinnings only where they can pay for themselves. Very careful costs were therefore kept of this operation, and are tabulated as follows

62 hours cutting at 25 cents	$15.50
35 hours hauling at 25 cents	8.75
56 hours cutting and splitting, 4 men 14 hours each at 25 cents	14.00
15 hours stacking cordwood at 25 cents	3.75
14 hours use of sawing and splitting machine at 50 cents	7.00
	$49.00

These figures represent actual costs to the lumberman to have the work done, paying the standard wage of 25 cents an hour in effect during 1921. Of course he is realizing a profit on the sawing and splitting machining above operating expenses and depreciation. On the other hand, no charge is made for the marking, which took about 3 hours. In actual practice it is hoped to have these thinnings made in the wintertime, the woodland owners doing the marking and supervising the cutting themselves.

Seasoned pine wood in stove lengths has a value in this section of the Eastern Shore of $6 per cord at the mill, which in this case is 6 miles from town. In view of the fact that the wood from this thinning would run smaller than the average, many sticks being only 2 inches in diameter, the lumberman deemed it advisable to sell it at $5.50 per cord.

The gross returns from the acre are thus	$60.50
The costs as above	49.00
The profit per acre	$11.50
Or per cord	$1.05

It would seem, therefore, that for growing pine thickets within, say, a 6-mile radius of a central market, the only drawback to the practicability of such thinnings would be the availability of such a cutting and splitting machine as the one described. It would, of course, be impractical for every woodland owner to have such a machine, nor in the opinion of the writer would it be necessary. Just as a thrashing machine makes the rounds of the farms in a given section during the summer, so in the winter a cutting and splitting machine could make the rounds in the same way—the woodland owner having his thinnings made and his poles stacked ahead of time.

FOREST FIRE RISK IN MASSACHUSETTS

By H. O. Cook

Chief Forester, Massachusetts Department of Conservation

Some time ago the writer contributed to *Forestry Quarterly,* Vol. XIV, No. 2, an article on forest fire risk, in which he attempted to show that the number of fires in the towns of the Commonwealth which might be called manufacturing communities was greater in proportion than in the remaining towns which might be designated as rural. Only the fire data of one year (1914) were used as a basis for this article and its conclusions.

There is a chance for much interesting and valuable research in this subject, namely, the relative risk, as the insurance people call it, in different types of land, said types to be based on forest conditions, soil conditions, and population conditions, either considered separately or together. The writer has attempted to make for Massachusetts a preliminary study along these lines. He has divided the State into five districts, each of which has rather distinct topographcial, soil, forest, and even economic features. In these five districts he has listed the fires of four separate years, 1918-1921, by districts, as shown in the tables, with an additional table giving the average of the four years' record. The fifth column of the table is the fire rate or hazard, and means the number of fires per one hundred thousand acres of area. The last column gives the population per square mile.

In order that persons not familiar with Massachusetts may properly analyze the tables it is necessary to give some information concerning the five districts.

Berkshire Hills.—This district includes that part of the State west of the Connecticut Valley, and is a region of hills and mountains ranging in elevation from 1,500 to 3,000 feet, arranged in parallel ranges north and south, with rather narrow valleys between. The underlying rock is largely limestone, which is overlaid with a fairly deep clay loam. The forest is largely of the northern hardwood type, and covers 75 per cent of the land area. Most of the population is confined to three river valleys, and over the rest of the area it is very sparse. Rainfall is generally plentiful, and streams abound.

One will note from the tables that this district has the smallest fire risk. This is undoubtedly due to three factors—small population, a moisture-retentive soil, and a good forest cover which has not been severely cut over. Of the three I give first importance to population, because a glance at the map indicates that most of the small number of fires are near the larger towns.

Connecticut Valley.—The tier of towns on either bank of the Connecticut River comprise this district. The land is flat, and the alluvial soil deep and rich. Almost every acre is under the plow, and forest does not cover ten per cent of the area. Besides an intensive farming population there are numerous cities and towns, so that the population ratio is high. In spite of this fact there are few fires, because there is nothing to burn. Every acre is in tillage.

Central Highlands.—This section includes Worcester County and the easterly ends of Franklin, Hampshire, and Hampden Counties. It is a country of rounded, flat-topped hills intersected with shallow valleys. Elevations range between 800 and 1,500 feet. The underlying rock is granite, but this is well covered with a deep glacial soil. Strange to say, the soil is sandy in the river valleys and loamy on the hills. The country is well forested to the extent of about 60 per cent of the area, but the forest is broken by areas of cultivated land. The forest has been severely cut, and there is much slash and sprout land as a result. Population figures show 235 to the square mile, but it is irregularly distributed, more than two-thirds of it being in five or six cities in the district, and the bulk of the towns are rural, some of them quite sparsely settled. Considering the high population ratio, and the large amount of forest land, much of it recently cut over, the fire rate is very small.

Eastern Section.—This includes all of the State east of Worcester County with the exception of Cape Cod. It lies largely within 40 miles of Boston, and is a region of cities and large towns. In spite of this fact there is a considerable area of forest land, not less than 40 per cent of the area being wooded. The topography is made up of low rounded hills, with a deep gravel loam soil. Small rivers and brooks abound in the valleys. Agriculture is carried on both in valleys and on hilltops. This region might have been divided into southeastern and northeastern, as the country west and north of Boston is somewhat different from that to the south. The first-mentioned section, included in Middlesex and Essex Counties, has a better soil and has a larger percentage of agricultural land, so that forest land is cut up into smaller

lots than in the towns of Norfolk, Bristol, and Plymouth Counties to the south. The population ratio is very high, but it must be noted that one-half the people of the district, about one and one-quarter millions, live within 12 miles of Boston, so that over the district as a whole the population ratio is not as high as the statistics would seem to indicate. The fire rate is the highest of the five sections, and is undoubtedly due to the density of population, much of it living in manufacturing centers and inclined to be irresponsible when in the woods. In Massachusetts we have on Saturdays and Sundays more fires than in all of the other five days of the week combined, so it is a pretty clear indication that they are caused by the city or town dweller temporarily in the woods either as an autoist, a tramper, a hunter, or a picnicker. Naturally it is those sections near by this class of population that have a high fire rate.

Cape Cod.—This section is characterized by a topography so slightly rolling that it may be called flat. The soil is light, but has streaks of loam very favorable to agricultural development, especially as it is free from stones. Most of the cultivated land is found near the ocean shore, and the interior of the Cape is a contiguous belt of woodland. Inasmuch as this woodland occupies the poorest soils it is low and scrubby, and the poverty of the soil has been accentuated by extensive fires in the past. The lack of streams and valleys, as well as the character of the soil and growth, is favorable to the development of extensive fires. In spite of the conditions favorable to fires it will be seen that the rate is remarkably low. Although it does not show in the table the fact is that a majority of the fires are caused by the railroads. The record speaks well for the carefulness of the people who live on Cape Cod. Although the population ratio is low the census satistics do not tell the whole story, because during the summer months the permanent population of 30,000 is increased to over 100,000. Speaking of railroad fires, the writer has noticed in this study that wherever the railroads run through a mountainous country and the tracks cling closely to river banks there are fewer fires than in a flat country where the railroad strikes directly across the country without reference to river courses. This result is due to several factors. Where a railroad is close to a river bank it is, of course, protected by water on one side of the track, and conditions on the other side are often damp. In the second place, in a hill country the valley land is largely agricultural, and the railroad tracks are striking through open country. These factors more than overcome the adverse factor of heavy grades,

on which engines are liable to set fires. In a flat country, on the other hand, the railroad runs through cleared and forest land indiscriminately, and the soil conditions may be very dry.

CONCLUSIONS

It seems to the writer that the following conclusions may be drawn from this study:

1. That the fire risk varies greatly with local conditions of soil, topography, forest types, and population, even in a State as small in area as Massachusetts.

2. That methods of fire prevention and control cannot be State-wide to be most effective, but must be modified by districts according to the risk involved. Our figures would indicate, for instance, that it would pay to spend ten times as much money in fire prevention in Middlesex County as in Berkshire. Practically no such large distinction is necessary or wise, but the data indicate that some modification of our methods and expenditures is needed.

3. That regulations for slash disposal should be modified to meet different conditions of fire risk, provided such regulations are at all drastic and call for the expenditure of money.

4. That railroads traversing a flat, woodland country need a more extensive system of fire prevention than railroads in the hills.

5. That amount and character of population determine fire risk where natural conditions are not widely different.

1918.

Section	Area	Number fires	Rate per 100,000 acres	Population per square mile
Berkshire Hills......	1,122,500	62	5	83
Connecticut Valley...	380,750	93	25	517
Cape Cod...........	367,300	90	25	60
Central Highlands...	1,341,300	441	33	235
Eastern	2,188,000	1,425	65	830

1919.

Berkshire Hills......	1,122,500	30	3	83
Central Highlands...	1,341,300	180	13	235
Connecticut Valley...	380,750	75	20	517
Cape Cod...........	367,300	110	30	60
Eastern	2,188,000	1,160	53	830

1920.

Section	Area	Number fires	Rate per 100,000 acres	Population per square mile
Berkshire Hills......	1,222,000	31	3	83
Connecticut Valley...	380,750	55	15	517
Central Highlands...	1,341,300	280	21	235
Cape Cod...........	367,300	95	26	60
Eastern	2,188,000	1,169	53	830

1921.

Berkshire Hills......	1,222,000	50	4	83
Cape Cod...........	367,300	40	11	60
Connecticut Valley...	380,750	65	18	517
Central Highlands...	1,341,300	357	27	235
Eastern	2,188,000	950	43	830

FOUR-YEAR AVERAGE.

Section	Area	Fires	Rate	Population
Berkshire Hills......	1,222,000	43	4	83
Connecticut Valley...	380,750	72	18	517
Central Highlands...	1,341,300	314	23	235
Cape Cod...........	367,300	84	23	60
Eastern	2,188,000	1,176	53	830

DETERMINING THE HEIGHT OF A LOOKOUT TOWER

By Ward Shepard

Forest Examiner, U. S. Forest Service

How high a lookout tower should be is as difficult to answer as the ancient question, How old is Ann? Like Ann's age, it may be deceptive and a blunder may lead to unpleasantness. A tower may be built that is ineffective because too low or needlessly expensive because too high.

The following described method was used to find the height of a proposed tower on Mt. Taylor on the Manzano National Forest. I do not know whether the method is new, but have never seen it used or described.

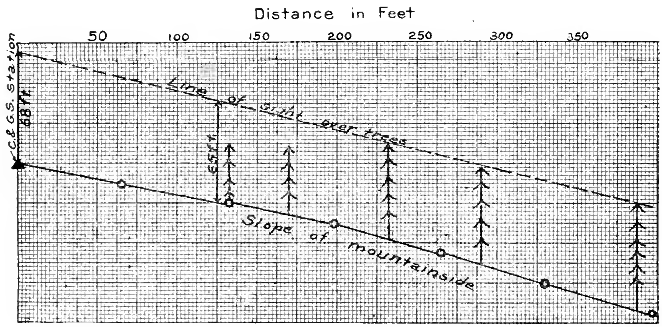

Fig. 1.

The view northwest of Taylor Peak is cut off by a stand of Engelman spruce extending nearly to the top of the peak and reducing the area of visibility by about one-third. As a consequence, the lookout-man has been required to ride about two miles northwest to Mosca Peak in order to see the country invisible from Mt. Taylor.

The problem then was to determine how high a tower was needed to look over this timber. Levels were run with an Abney hand level from the summit of Taylor Peak down through the highest fringe of

timber, one traverse going through the left edge and one through the right edge of this fringe. The heights and positions of the tallest trees along the lines of these levels were determined. These heights can be easily determined by measuring 100 feet from the base of the tree, on level ground, and sighting at the top of the tree with the hand-level, the height being expressed in feet by the reading in per cent. To this is added the height of the instrument above the ground.

These levels and the heights and positions of the trees were then accurately platted on cross-section paper; and a straight line, representing the line of sight, drawn through the tops of the trees as shown in figure 1. The vertical distance from any point on the ground to this line of sight is the necessary height of the lookoutman's eye in order to see over the tree-tops. This calculation shows that this height, at the summit of the peak, is 68 feet and down near the timber it is 65 feet. A tower near the timber would permit looking over the peak and down the opposite side, and the timber would give the tower shelter from the wind.

It still remains to be seen, by actually building the tower, whether this is the correct height, but there seems at least to be no fault in the method, if accurately applied.

A POSSIBLE EXPLANATION OF CERTAIN FOREST FIRES OF UNKNOWN ORIGIN

By Henry Schmitz

Laboratory of Forest Products, University of Idaho, Moscow

Fires of unusual origin which might be the cause of forest fires are, of course, of immediate interest to foresters and lumbermen. The following record of a case of "spontaneous combustion" in a single dropping of horse dung is therefore reported. The circumstances surrounding this case are briefly these:

On August 7, 1921, at approximately 4 p. m. it was observed [1] that a single dropping of horse dung exposed to direct sunlight back of Morrill Hall on the University of Idaho campus began to smoke faintly. The volume of smoke steadily increased and the dung heap finally burst into flame. The maximum temperature on this day was 91° F.

Immediately after the flame was noticed a detailed examination of the droppings was made in order to determine if the combustion may not have been due to the action of the sun's rays striking a piece of glass near the heap, or whether it was due to other causes. This examination revealed the fact that there was no broken glass on or near the heap and there was no evidence that the fire started through any other means that through "spontaneous combustion." The evidence also all pointed toward the fire having started in the interior of the heap rather than on the surface.

It is a well known fact that during the decomposition of vegetable matter, particularly in the form of piles of horse dung, a quite high temperature may be produced due, in part at least, to bacterial activity. The present observation, however, deals with but a single dropping, and with dung that was not over ten to fourteen days old, and probably not over four. The horse had been feeding on green grass which would influence the physical character of the dung.

On account of the far reaching effects of forest fires started in a manner as above described, it may not be amiss to briefly discuss the physiological and physical factors obtaining in a pile of dung which

[1] This observation was also made by at least six men of the faculty of the College of Agriculture.

might, under certain conditions, cause its bursting into flame. Due to the efforts of Mitscherlich, Ellenberger, and others, the fact was established that the fungus flora of the intestines of herbivorous animals contains many forms of bacteria of the cellulose dissolving type. These organisms, under anaerobic conditions, break down cellulose into methane, carbon dioxide, and water, the methane, of course, being an inflammable gas. The question might arise as to whether anaerobic conditions actually prevailed in this particular pile of dung, but it is entirely possible, since, due to rapid drying, the outer surface was more or less "case hardened" and due to the decomposition going on in the interior of the heap, the oxygen was gradually used and no more, or very little more, entered, due to the continual internal gas pressure.

It is a question if the heat release due to the above decomposition would raise the temperature sufficiently high actually to cause the material to ignite. Authorities differ as to whether or not the heating of manure piles and of damp hay is a bacterial phenomenon. Some writers on the subject hold that some cases of "spontaneous combustion" should be attributed to the agency of the thermogenic bacteria and that although the train of events leading to the actual bursting into flame is not fully understood, bacteria play a part in the initial stages of the process. Miehe, after an exhaustive investigation of the subject, presents strong evidence of the thermogenic power of certain microorganisms. Still other writers in this field maintain that the heating process is due to chemical reaction unaided by bacterial activity. Most of the later observations tend to support the latter theory.

In this particular case the shape of the droppings may also have been a contributing factor. The individual parts of the dung heap being more or less spherical in shape, may in some way have concentrated the light in the same manner as a lense and the temperature thus raised to the kindling point. Then, too, a spherical surface represents the minimum surface area for any given volume and hence would be a minimum amount of radiation. It is probable, then, that the above discussed combustion was due to a combination of bacterial, chemical and physical conditions, but it is not improbable that this same combination of conditions may recur at any time and result in a forest fire.

AERIAL FOREST FIRE PATROL IN OREGON AND CALIFORNIA

By Charles W. Boyce

Observer in Charge Oregon Patrol, 1920

To those who live in the settled parts of the country the matter of forest-fire protection is largely suppression. A fire of slight consequence can hardly be started before someone sees it and reports it to the one responsible for its suppression. Here detection is not an important matter; it is taken care of automatically through the natural cooperation of people living in close harmony.

In the large forested regions there is a vast difference. There are few people living in the woods; there are large areas in which no one lives and through which no one passes excepting the stray hunter and the forester. The means of transportation and communication are few. The nature of the country is usually mountainous, wooded and difficult for the casual passerby to see the surrounding region. Under these conditions, it is plain, that the sighting of fires can not be left to chance. An organization must be established whose sole duty is to find these fires as soon after they occur as is humanly possible. Herein lies the importance of detection as related to the forest fire problem.

It is obvious that every fire starts in a small way, no large area suddenly flares up in flames at once. The fire starts from one of any number of causes in one place from which it spreads according to the conditions, gradually gaining volume and covering an increasingly larger area. It naturally follows that the quicker action in the form of efficient work by a crew of fire fighters is brought to bear upon a fire, the greater will be the opportunities for its quick suppression at a minimum damage. However, this quick action can not be supplied until it is known that there is a fire and where it is.

The forest protective agencies of the West have realized for a long time the importance of prompt detection, consequently they have expended much effort in establishing a system of lookouts on high and commanding peaks whose sole duty consists in watching the surrounding country for the tiny wisp of smoke denoting the forest fire in infancy. In 1919 a new adjunct was added to this detection sys-

tem through the cooperation of the Air Service of the Army. The aerial patrol of the forested regions was established and operated throughout the season. This was continued during the season of 1920 with gratifying results.

The airplane furnishes a means of direct vertical view of any fir situation without the distortion of angular view or without interference from intervening ridges. The airplane is mobile and can go directly to the fire, circle above it gathering the information that is desired, determining the exact status of the fire, its location, and character of material in which it is burning. During the period of smoke blanket when the country is completely overcast with smoke, the view from the airplane is not so seriously hampered as that of the lookout.

The aerial patrol system has been extended to date throughout the forested regions of Oregon and California, consisting of twelve different routes varying from 200 to 500 miles in length. These routes are flown from bases selected and maintained by the Air Service. The airplanes, or "ships," as they are commonly called, were furnished, operated and maintained by the Air Service. To a limited extent in California, and wholly in Oregon, the observers were furnished by the United States Forest Service. The reporting of the fires to the suppressive forces was handled throughout by the Forest Service.

The famous DeHaviland airplanes rebuilt and equipped with 400-horsepower Liberty motors, were used throughout the 1920 season. Their performance under the hard usage of long and difficult patroling was nothing less than marvelous, making a record, in Oregon, of 150,000 miles with but three forced landings which resulted in no injuries of a serious nature.

Each ship assigned to patrol was equipped with a radio sending set, consisting of a small, wind driven generator on the landing gear, with the sending keys and attachments in the fuselage. The antennae, a specially constructed wire some 250 feet long, was dragged behind the ship while in flight.

At the bases and in some instances at other points ground receiving stations were established, equipped with the small compact, but highly efficient Signal Corps 59 radio set. The receiving stations were so located that when a ship on patrol passed from the receiving radius of one station, it went into the radius of another, thus being in constant touch with one base or other. By this means all new fires discovered and the status of old fires could be reported immediately.

The radio performance, when considered throughout the course of the 1920 season, was fairly good. There was some trouble experienced during the first part of the season, but by making adjustments and constantly testing the equipment these troubles were largely eliminated.

The patrol routes were so organized as to cover as much of the timbered section of the regions as possible. At first definite routes were laid out and the patrols required to fly them. It was found, however, that more accurate results could be obtained by the ships going directly to each fire, consequently strict adherence to a prescribed route could not be maintained.

Each ship on patrol carried two men, a pilot and an observer. The former attended to all of the flying duties, the latter confined all of his attention to finding and reporting fires. Flying as flying alone soon became an old story, and the fun of the flying soon died down into a steady work. Competition in attempting to secure first discoveries of the fires reported, developed and served to keep everybody keyed up to the situation at all times.

To adequately cover the territory assigned to a route required from four to six hours, dependent upon the number of fires discovered. At noon a landing was made to replenish the gasoline and oil supplies for the continuance of the flight. An average rate of 100 miles per hour was maintained at any altitude of approximately 9,000 feet.

As soon as a fire was sighted from the airplane, the pilot flew to it. The observer noted on a specially prepared form a description of the situation, including size, location, character of material in which it occurred, etc. This was immediately sent by wireless telegraph to the nearest base. Here, the report was plotted on a map, checked and forwarded by telegraph or telephone to the suppressive headquarters of the district involved. After the suppression force had extinguished the fire the actual location was sent back to the patrol reporting base to serve as a check upon the work of the observers.

The chief advantages of the aerial patrol, as referred to previously, consists of direct vision, mobility, ability to cover a large area in a short time and at a small cost per acre, ability to see through a smoke blanket with more ease than a lookout, and ability in obtaining an adequate idea of the fire situation as it concerns large districts. There is an added advantage in the fact that a quick reconnaissance of a large fire can be made, obtaining information as to the activity of the fire on all sides. This was found to be of great assistance in directing the fire-fighting crews in their work of suppression.

The fighting of the large forest fires of the Northwest is seriously hampered by "spot fires," fires caused by wind-carried sparks, some mile or more in advance of the main fire. Lookouts have been used to some extent in attempting to watch for these spot fires, but to little success. Their fixed position and long oblique view through the smoke screen has lessened their effectiveness. The airplane can go directly to any part of the fire and, looking down vertically with the light rays, can see more clearly through the smoke. This is found to be of great advantage in handling a large fire.

The disadvantages of the airplane from a detective point of view consist mainly in the fact that it passes over a given area but once or twice a day, while the lookout is always on the job, so to speak. The inability of the airplane to fly effectively directly following thunderstorms, due to the low clouds, is another disadvantage which is, however, made up by the lookout who, while shut in to a large extent by the clouds, can get an occasional glimpse of the country through rifts in the cloud screen.

Before the patrol actually started operations, it was thought by many that accurate location of a fire could not be obtained from the airplane, due to the lack of adequate maps. While the lack of detail and accuracy in the maps used, which were the best obtainable, did interfere to some extent, fair accuracy in location could be secured, however. The observers were given ample opportunity to learn their routes before the fire season started. By so doing over 90 per cent of the fires discovered by the Oregon patrol were reported within a quarter of a mile of their actual location as checked by the one in charge of fighting the fire.

The speed of the patrol, promptness in reporting, and general utility are shown by the fact that the Oregon Patrol sighted 720 fires out of a possible 1,100, and that of the 720 sighted, 465 received credit for first report. The number of first reports received by the patrol in districts which were adequately covered by the lookout system was much lower; in the districts where the lookout system was not developed, the aerial patrol was the chief reliance.

The effect of the aerial patrol is not solely confined to detection. Without a doubt its value as a publicity unit for forestry has never been equaled. Everybody was interested in the patrol, people came for miles to visit the bases and look over the ships and other equipment. This resulted in a decided moral effect which was shown in the greater care exercised by people in the woods in regard to fires. Ranchers

who had been accustomed to burn their slashing and clearing débris without permit at any time that suited their fancy were always aware of the fact that at any moment an airplane might pass overhead and report their fires. Forest rangers who never before were called upon to issue many brush disposal permits were literally swamped with requests. This gave them an opportunity to confine the burning to periods when the danger of a fire spreading and getting beyond control was slight.

Furthermore, all of the benefits of the patrol were not confined to the forest protective agencies. The advantage of the patrol as a means of training Air Service personnel is unquestioned. They may be called upon at any moment for flying of a more combative nature and not be found wanting. The patrol is a constant war game requiring the best effort of all concerned. The flying necessary in training produces good flyers only; in the patrol the same flying results not only in the training of pilots, but at the same time accomplishes a needed and very much worth while work.

Notwithstanding the advantages of the aerial patrol over the lookout system, in many instances it can not be supposed by even the most enthusiastic advocate of aviation who knows the problem of fire protection that the aerial patrol should replace the lookout system. The lookout system is the basis and will continue to be so. It is constantly operative. However, as much as the lookout system is needed so also is the aerial patrol. Each supplements the work of the other, and by an efficient combination of the two systems, an organization can be developed which will be able to find all of the forest fires before they have gained sufficient volume to become dangerous. The future detection systems of the forests should include both; the increased promptness and the greater certainty in finding all fires will demand it.

CONSERVATION OF THE TIMBER OF BRITISH COLUMBIA[1]

By R. W. Hibberson

Ryan-McIntosh Timber Company

To the average man in the street, British Columbia is all timbered. He travels by train through the interior of British Columbia, or by steamer up the Coast and the country everywhere looks green; therefore it must be timber. If you told him there is every danger of a timber famine in British Columbia within 15 years, you would be ridiculed; but there is a very decided danger of a timber famine, and before many years lapse, we will all begin to feel it.

Ten years ago, the center of the logging industry was within a radius of 50 miles of Vancouver. Today, it is from 150 to 200 miles from Vancouver, and in some cases operators are towing logs as far as 600 miles to their mills, and an average tow of 200 miles is quite common.

Ten years ago, the average cost of logging was $5 per thousand feet; today it is nearly $20 per thousand feet and in some of our cedar camps last year, the cost was over this figure.

Ten years ago, most of our logging was done within a mile of the salt water; today we are hauling by railroad 10 to 20, and in some cases more miles by railroad to salt water, before we commence to tow logs to the mill.

The interior of British Columbia has the same conditions, where formerly saw mills were built in the heart of the timber, today, logs are brought distances up to 70 miles by water and by rail. This means heavy expense and conditions are getting worse every day. The general public is clamoring for cheap lumber. There can be no cheap lumber in the future, if the logger and mill man are to make a fair profit on their investment. Lumber will steadily rise in price as the timber recedes farther and farther away from centers of population, and the cost of getting the logs to the mill increases year by year.

Formerly a logger with a capital of $5,000 to $6,000 could open up a camp and produce logs; today his machinery will cost him approxi-

[1] Address recently delivered in Vancouver before the Associated Boards of Trade of British Columbia.

mately $100,000 before he can commence to operate. I have in mind one operation, not 20 miles from here, where a logger spent $125,000 building his logging railroad and putting in camps, etc., before he made a cent, then when he was ready to operate a slump came and he had no market for his logs.

The price of logs governs the price of lumber; and with the consumer demanding cheap lumber, the mill man naturally is demanding cheap logs. The logger in order to get his logs as cheaply as possible is devastating our forests; cutting only the timber that can be cheaply handled, smashing down all the smaller timber in the process of logging and leaving in the woods to rot or to be burnt, some 30 to 40 per cent of the volume of the timber on the ground. He cannot afford to attempt to log much of the timber on the high elevations or on the rough ground; broken timber is left and on most operations on rough ground, fully half of the timber never reaches the mill, it being broken up and left on the ground.

There is no country in the world that would tolerate the wasteful logging methods practiced on the Pacific Coast of Canada and the United States. It is not logging; it is forest devastation. Whom are we to blame?

The logger, in order to make a fair return on his investment, and log all the timber on the tract, carefully taking off, first of all, the small timber, and then logging the heavy timber; must have an increased price from the mill for his logs. Therefore, the consumer cannot look for any cheap timber in the future, as the cost of operating is continuously climbing.

We have been credited in British Columbia with having 350 billion feet of standing timber. Of this I have no hesitation in saying that there will not be 100 billion feet actually taken to our saw mills in the form of saw logs. This figure of course refers to our virgin timber. Our present output is approximately two billions of feet per year; this figure will be more than doubled within five years, and by 1930 British Columbia will be called upon to supply at least six billion feet per year, possibly more.

As is well known, the eastern United States is almost denuded of timber, they are already dependent on eastern Canada, the southern States and the Pacific Coast for 90 per cent of their domestic requirements in lumber. The southern States which now cut approximately 12 billion feet per year, will, within seven years, cease to be

an exporter of lumber, and the Pacific Coast will be called upon to supply the deficiency.

The United States annually uses 38 billion board feet of lumber; that is to say, all the saw timber we have in British Columbia would only last the people of the United States three years. Her wood fuel consumption is enormous. Last year it was 110 million cords. The United States railroads used annually 125 million railroad ties, and six billion feet of timber is used just for boxes, crates, and barrels.

Already the people on the other side of the line are preparing for a timber famine. Reforestation is practiced in many of the eastern States. The pulp and paper companies, who formerly were self-supporting in pulp timber, now obtain two-thirds of their pulp, paper, or pulp wood from Canada; and if as is quite probable, Canada prohibits the export of pulp wood across the line, most of these companies will be put out of business, and investments totalling hundreds of millions of dollars will be wiped out.

In Quebec and Ontario, the large pulp and paper companies realize the necessity of a continuous supply of timber; and although they still have thousands of square miles of timber, they are now engaged in systematic reforestation on the cut-over areas; as fast as a tract is logged, they plan to reforest it. Their logging methods are supervised by Government foresters and no waste is tolerated. The Government of the Province of Quebec is now planning to fix the maximum annual cut of timber and also a minimum cut, to stop speculation on Government lands. They have sent young forestry engineers to Europe to study the best forestry methods and are engaged in reforestation on a large scale.

It is time that British Columbia took warning and reorganized their forest branch.

In Quebec and Ontario timber is cut down to, in some cases, four inches on the stump for pulp making, and in this connection, it may interest you to know that last year some of the paper mills of the United States sent crews of loggers into the remote sections of Ontario and Quebec, where the freight alone on cord wood amounted to $16 and over per cord. Last year the United States pulp and paper mills used over five and one-half million cords of wood. This means a solid pile of wood four feet high, four feet wide 9,000 miles long; and bear in mind, this amount is used every year, and the amount is constantly increasing.

In British Columbia, in the Coast district, we waste most of our small timber. Hemlock 12 to 20 inches on the stump is not considered to be worth logging. In almost any logging operations on the Coast you will see the small hemlock left on the ground; literally on the ground; for the high lead method of logging breaks down practically all the small timber on the tract, and when the operation is completed it reminds one of a scene in a Belgian forest after it has been devastated by the Hun.

The average timber license on the Coast carries approximately 12 million feet of timber; the average amount logged off a timber license during the past 15 years is five million feet. Government licenses have logged as high as 18 million feet, but a great many have only yielded three and four million feet.

Only the timber on the lower elevations has been logged off, the balance being left a prey to fire and wind storms, which every year claim millions of feet. What is the remedy for this? We cannot force the logger to take off this timber, if by doing so, he cannot make a profit. The average consumer of lumber says he cannot afford to pay fancy prices for lumber in order that the timber may be protected and logged clean. But what will be the ultimate result if we do not stop this waste? Our virgin timber gone, all our wood working plants or the majority of them will be forced to close, and as lumbering is the chief industry of British Columbia we shall suffer a great loss.

Figures for 1920 give lumbering production as 92 millions of dollars.

Figures for 1919 give lumbering production as 70 millions of dollars, one-third as much again as mining and fishing combined, which only total 48 millions. There are many other industries dependent on the lumber industry. Our wire rope plants, iron works, food supply houses, and farmers will all feel the loss. Our salmon canneries, mines, and railroads are large consumers of lumber and will keenly feel the loss of our timber, which will increase their operating expenses enormously.

I have no doubt that you think I am painting a very harrowing picture and one that can never come about, but it has come about in other parts of this continent, and will certainly come about here unless we can take measures to prevent it. The fact that we can ship lumber across this continent by rail into New York State, to keep the wood using plants there alive, proves it. New York State once was heavily forested like British Columbia. Her requirements today are

300 board feet per capita. She can only get from her forests 30 feet per capita; the balance of 90 per cent she must import from Canada, the Pacific Coast, and the southern States.

Less than 5 per cent of the original forests of the New England States remain. The original pine forests of Michigan, Minnesota, and Wisconsin, estimated to contain 350 billion feet, talked of as inexhaustible, are now reduced to six billion feet. These densely populated States are now dependent on timber grown and manufactured elsewhere; and in a very few years will be absolutely dependent on Pacific Coast timber.

The bulk of the timber used in the eastern and central States during the past 15 years was grown in the pine forests of the South, but these forests have been so heavily cropped that they have now been reduced from 650 billion board feet to 150 billion board feet. Much of this is small timber on cut-over land; and within seven years these States will cease to be a factor to reckon with in the export business, for they will require their timber for their own domestic use.

At the last meeting of the Southern Pine Association it was estimated that 80 per cent of their mills will close within seven years, not having any further supply of timber for their use. This means that British Columbia and the Pacific States of the United States will have to supply the wants of the United States market and the Prairie Provinces of Canada in addition to filling the wants of the export trade, with Europe, Australia, South Africa, the Orient, and South America.

A. L. Clear, President of the Vancouver Lumber Company, some time ago had courage enough to state that we had not nearly the amount of timber in British Columbia that we were credited with. He estimated our resources at approximately 150 billion feet. Dr. Judson Clark, a well known authority on timber in British Columbia, estimates the total stand of accessible merchantable timber to be approximately 100 billion feet. Personally, from 17 years' observation and examination of the timber in British Columbia by our firm, I incline to the figures as given by Dr. Clark.

British Columbia has an area of 359,000 square miles, of which only 40,000 miles is commercially forested; 110,000 square miles of our timber lands containing 665 billions of feet has been totally destroyed and as the humus has been burned it will be centuries before it is again covered with a forest growth. The Slocan and southern boundary countries of British Columbia have been so burned over

that many of the mines and mining towns have to ship their mining timber and fuel by rail, distances up to 70 miles, and this country a few years ago was heavily forested.

Of the 40,000 square miles of commercial forest in British Columbia, only 50 per cent can be seriously considered as containing accessible loggable timber; the balance being on rocky steep ground, where the cost of logging and the breakage would be so great that it would not tempt a logger to operate for many years to come.

The virgin growth of timber in British Columbia is steadily decaying and should be cut and marketed, but the young second growth on which we depend for our future supply of lumber should be jealously preserved. At present we are recklessly cutting it for tie timber, poles, and mining timber, destroying fully 30 per cent of it during the operation. It is common practice to leave 20 to 40 feet of good sound butt logs in the woods, because it is too large to hew into ties. The same condition applies to operations where mining timber is being logged. This should be checked, and without waste of time. Depletion of our forests in British Columbia within 20 years with a resultant slump in all enterprise that depends wholly or in part on forest products can only be averted if action is taken without further delay.

The action we would propose is that private timberland owners adopt logging methods that will protect and preserve young growth, and leave logged off lands in condition for forest renewal, then the young trees of today will be of merchantable size when needed. This is dependent on keeping fires out of the forests, so that young trees will have an opportunity to grow.

It has been shown on examination that, unless logging slash is burned over, the reproduction is very poor, the heavy slash shading the young seedlings. It is necessary for a fire to follow logging operations in order to prepare the ground for seeding. This should be undertaken by the Government, which can take every precaution to avoid disastrous fires.

It takes approximately 80 years to produce trees of commercial size that will make ties and piling for the Coast or saw logs for interior mills. Eventually our Coast mills will have to adapt their cutting machinery for small logs, for the virgin timber once gone can never be replaced. It takes from 200 to 400 years to produce our large fir timber, and double that to produce our big cedar. The fortu-

nate owner of a tract of virgin cedar and fir will, if only he can afford to hold it for a few years, reap a rich reward.

The relationship of timbered areas to future needs, their incentive to tourist travel, the fact that they serve as water reservoirs, etc., make the public vitally interested in seeing them continued. The reforestation of logged-off areas unfit for agriculture in the interior of British Columbia and portions of the Coast district, and protection of such areas against fire, is proposed as the solution of the continued timber supply problem. Depletion of our forests has not resulted from the use of the forests but from their devastation, from our failure while drawing upon our reservoirs of virgin timber to also use our timber growing land.

The reforestation will have to be undertaken in the main by the Government. It is not practicable to enforce the practice of forestry on private timberlands, for the growing of timber of sawlog size is an operation too long in time and offering too low a rate of return to attract private capital, always excepting pulp and paper companies who can use timber long before it becomes sawlog size. (In this connection, Pennsylvania planted nine million trees in 1919; 50 million trees since 1900.)

Very shortly we shall see a large increase in the number of these plants, and it is to be hoped that Canadian and Empire capital will be behind them.

In conclusion let me say that it is vitally necessary that newspaper publishers within the Empire should get together and acquire supplies of timber against the time when they will be worrying not about the price of timber but about the fact that they cannot get supplies at any price.

SECOND ANNUAL MEETING OF THE ASSOCIATION OF STATE FORESTERS, AT CHESTERTOWN, N. Y., SEPT. 20-22, 1921

The original decision to hold the meeting at Itasca Park, Minnesota, at the invitation of President Cox, was changed early in September, in favor of the Adirondack Region of New York, at the invitation of the New York Conservation Commission. President Cox, who had already gone far with plans for the meeting in Minnesota, unselfishly agreed with the rest of the Executive Committee that the meeting should be held in the white pine blister-rust region and devoted primarily to a study of that disease. This decision was reached because of an increasing realization not only of the extreme seriousness of the disease if it is not adequately combated, but of the entire feasibility of combating it at a very low cost as compared with the value of the white pine stands, and of the very pressing importance of securing adequate steps to this end by both the Federal Government and the States.

In the absence of President Cox, the meetings were presided over by Vice-President Besley.

The following State Forestry officials were present: California, Merritt B. Pratt, Deputy State Forester; Maine, Samuel T. Dana, Land Agent and Forest Commissioner; Maryland, F. W. Besley, State Forester; Massachusetts, W. A. L. Bazeley, Conservation Commissioner and State Forester, and H. O. Cook, Chief Forester; New Jersey, Chas. P. Wilber, Chief Firewarden; New York, C. R. Pettis, Supt. of State Forests, and Wm. G. Howard, Asst. Supt. of State Forests; Ohio, Edmund Secrest, State Forester; Oregon, F. A. Elliott, State Forester; Pennsylvania, Gifford Pinchot, Commissioner of Forestry; Vermont, W. G. Hastings, State Forester; Virginia, Chapin Jones, State Forester; West Virginia, A. B. Brooks, Chief Protector, Forest, Fish, and Game Commission; Wisconsin, C. L. Harrington, member of the Conservation Commission representing forestry.

There were also present S. B. Detwiler, in charge of blister-rust control, Bureau of Plant Industry, Washington, D. C., and a number of other representatives of the bureau in blister-rust control, including the State Agents for Maine, New Hampshire, Vermont, Massachusetts,

Connecticut, New York, and Minnesota, as well as several men in the investigative branch, and Mr. Posey, in charge of the enforcement of the quarantine for the protection of the far Western States. Among the other guests were J. G. Peters, U. S. Forest Service; G. C. Piche, Provincial Forester, Quebec, Canada; H. A. Reynolds, Secretary Massachusetts Forestry Association, and L. H. Pennington, Professor of Forest Pathology, N. Y. State College of Forestry. Col. Greeley was unable to accept an invitation.

The only standing committee appointed at the Harrisburg meeting, one on standardization of fire-protection reports, consisting of Messrs. Pettis, Pinchot, and Elliott, did not make an extended report, but Mr. Pinchot discussed some plans he had in mind on the subject; the committee was continued another year and a report on "standards for estimating fire-damage" was added to its work.

The technical and practical aspects of the blister-rust problem were discussed by Mr. Detwiler, Dr. Pennington, and others.

There was a discussion of the increased express rates on nursery-stock, including statements as to what had been done in an effort to combat them in several States.

RESOLUTIONS ADOPTED

WHEREAS, Pine bark beetles are causing annual loss of large amounts of mature yellow pine timber, and

WHEREAS, Control of insect infestations in this class of timber is a demonstrated possibility, and

WHEREAS, There are now before Congress two identical measures, Senate Bill 2084 and H. R. 7194, providing an appropriation of $150,000 whereby the Federal Government may institute control measures on government-owned lands in Oregon and California, and

WHEREAS, Private owners in the locality are unable, though willing, to enter upon an extensive control program to rid their lands of pine bark beetles because of intermingling of Government and private holdings; now, therefore be it

Resolved by the Association of State Foresters in regular meeting assembled that we urge passage of the legislation above referred to, and further feel it to be the duty of the Government as the logical leader in forest matters to lead the way in projects of this nature which benefit not one region but the country as a whole.

WHEREAS, Proposals have been made in connection with the contemplated reorganization of the executive branch of the Federal Government to transfer the Forest Service or certain of its activities from the Department of Agriculture to some other department, and

WHEREAS, Both the administrative and investigative activities of the Forest Service are concerned primarily with the growing of successive crops of timber,

both on wild lands and on farms, and are therefore strictly comparable to and closely associated with the other activities of the Department of Agriculture; and

WHEREAS, The protection, production, and utilization of forest crops, together with the economic and statistical studies connected therewith, are so intimately related as to make forestry a unit which must be handled by a single organization, and

WHEREAS, The Forest Service in its present position as an integral part of the Department of Agriculture has achieved a well deserved reputation as one of the most efficient organizations in the entire Government service; and

WHEREAS, Any action that would cripple the effectiveness of the Forest Service would also react unfavorably on the effectiveness of the forestry work in the various States, which to a considerable extent look to it for leadership and co-operation; therefore be it

Resolved, that the Association of State Foresters believes that the transfer of the Forest Service, or of any of its activities, from the Department of Agriculture to any other department would be detrimental to the best interests of forestry in this country and is squarely opposed to such action.

WHEREAS, There has been introduced into this country from Europe the white pine blister-rust; and

WHEREAS, This is an infectious disease which attacks white pine, the most valuable timber tree of the Eastern United States, the continued production of which is essential to the maintenance of the necessary timber supply and therefore to the welfare of the country; and

WHEREAS, It has been positively demonstrated that this disease can be controlled at a reasonable cost by the removal of currants and gooseberries within 200 yards of white pine forests; therefore be it

Resolved, That the Association of State Foresters emphasizes the serious destructive effects of the disease and the extreme necessity for securing appropriations to control the spread of this disease where it is established and to prevent its introduction into other white pine areas; and be it further

Resolved, That the association strongly urges that a Federal appropriation of $300,000 be made for demonstrating methods of control to pine owners in co-operation with the states, and for strict enforcement of the Federal quarantine prohibiting shipments of blister-rust house plants; and be it further

Resolved, That this association recommends that all State foresters investigate conditions relative to the present and future control of this disease in their own States, and cooperate earnestly in the efforts being made to prevent its further spread. It is recommended that States with five-leaved pine interests take immediate steps to bring the danger from this disease to public attention through suitable publications and other means and appropriate adequate funds for the control of the disease; and be it further

Resolved, That a copy of this resolution be sent to the U. S. Secretary of Agriculture, all members of Congress, and the appropriate official in each State.

Resolved, That the Association of State Foresters expresses its appreciation and extends its thanks to the N. Y. Conservation Commission, and particularly to the members of the Division of Lands and Forests, for their hospitality and their efficiency in arranging for a most pleasant and profitable meeting of the Association.

The following officers were elected for the ensuing year: President, W. A. L. Bazeley, Massachusetts; Vice-President, Merritt B. Pratt, California; Secretary-Treasurer, Chapin Jones, Virginia; additional members of the Executive Committee, Samuel T. Dana, Maine, and C. L. Harrington, Wisconsin.

A telegram of greetings and good wishes was sent to Dr. B. E. Fernow, at his home in Toronto.

Immediately after the meeting, the Executive Committee voted that the next meeting be held at Itasca Park, Minnesota, in the summer of 1922.

COMMENT BY THE SECRETARY

For the benefit of those members who could not be present, the Secretary wishes to say that the resolution adopted expressing the thanks of the association to the New York members for the efficiency with which they handled the local arrangements was not a perfunctory matter, but was intended to convey our genuine admiration and sincere appreciation. We were shown every phase of the blister-rust problem in a most interesting and instructive way, as well as given a considerable insight into the general forest conditions of the Adirondacks, their fire-tower system, plantations, slash conditions after lumbering, the largest forest nursery in the United States in operation, etc.

An admirably clear diagram of the trip and description of the points of interest and the matters that were studied was furnished each member of the party by the Conservation Commission, from whom a copy can perhaps be attained by those who were not present.

The thanks of the Association are also due to Mr. Detwiler and the members of his staff for the thoroughness and clearness with which the blister-rust situation was shown to us. This could not have been done better.

The Executive Committee will do whatever seems feasible to carry out the wishes of the association as expressed in the resolutions adopted. Suggestions as to other activities should be sent to any member of the Executive Committee.

REVIEWS

Working Plan for a Communal Forest for the Town of Ithaca, New York. By John S. Everett, Cornell Exp. Sta. Bul. 404.

The possession and development of communal forests in the United States, especially in the densely populated areas of the East, should appeal to the public. To a forester it seems rather remarkable that so few cities avail themselves of this method of providing extensive recreational grounds, and a profitable income from wood products grown on land which in many cases provides a water shed for the municipal supply. Such municipal forests would furnish opportunity for labor, a desideratum of no mean moment in times of business depression.

The bulletin reviewed offers a means for interesting the thousands of municipalities which could profit from the establishment of municipal forests.

The bulletin starts out with some generalities or suggestions to the point, such as the size of the average municipal forest, ultimately about 1,000 acres or more, the cost of land to be purchased at seldom more than $10 per acre, the methods of acquisition possible, such as by gift, purchase, condemnation, and lease, provided the State has passed laws authorizing acquisition and development of municipal forests.

The usual regular order of procedure after acquisition follows, such as surveying and marking the boundaries, the preparation of topographic and type maps, including cultural features, and the areas needing reforestation.

Next comes the development of the area with permanent improvements, such as roads, trails, and fire lines, and with forest planting, which is sure to play an important part.

Thinnings and improvement cuttings plans are then outlined for portions of the area, and administrative details and arrangements are always necessary. The above are the general considerations usual to all municipal forest problems.

The author then proceeds to apply the principles in a working plan prepared for a communal forest for Ithaca. As to the specific plan for the Ithaca forest, the description is complete, and the plan proper

is largely a planting plan. The whole plan is for only ten years, after which a more elaborate one may be prepared. The stands are largely immature and present chiefly problems in improvement cuttings rather than in harvests. The author's statement that the Von Mantel formula is the only one of the eighteen methods mentioned in "Theory and Practice of Working Plans" which is practicable for the conditions, is not supported by reasons.

While the author determines the annual and the next ten-year periodic felling budget, using Von Mantel's formula, this operation seems at first thought rather pedantic, as the author of the plan does not propose to cut the indicated amount, since "because of the small size of the softwood timber, it would be inadvisable to remove all of this (budget) and it should be allowed to accumulate." The following rules set down by the author of the plan were perhaps sufficient during the next ten years without the budget formula:

(1) Dead, dying, and diseased trees are to be removed first; also windfalls.

(2) Cutting should be such as to benefit the remaining stand.

(3) Trees of poor form and undesirable species should be removed. Along the ravines and along roads and trails, the marking should be light.

However, the application of the formula might serve as a check in the volume to be cut and therefore be worth calculating, especially as practically no labor is involved other than that already employed in taking stock. W. J. M.

The Regeneration of Sal (Shorea robusta) Forests: A Study in Economic Ecology. By R. S. Hole, Indian Forest Records, Vol. VIII, Part II, 1921.

For many years foresters in India have given much attention to problems centering around the regeneration of Sal (*Shorea robusta*), a species of much economic importance. Until recent years, however, no systematic and consecutive research has been applied to these problems. As it is at present, the regeneration of Sal forests is very slow and uncertain. Twelve years ago the Research Institute at Dehra Dun began a comprehensive ecological study of the factors influencing the development of Sal seedlings in order to discover a practical method for speeding up the period of regeneration and rendering it more cer-

tain. These problems are of much economic importance in Indian forestry.

This study has been one of economic ecology and the results so far attained are published in the article under review. The paper covers such a wide field and is so complete with statistical information, it scarcely permits of adequate review in the space available in the JOURNAL. The reviewer has seen no recent treatment of research on regeneration so complete and suggestive as this report by Mr. Hole and it should be read by all American foresters engaged in research on this subject.

The plan under which the investigation has been carried out during the past twelve years was well considered and the following definite lines of research undertaken:

1. Experiments to test the effect of soil composition, soil moisture, soil aeration and light intensity on the development of Sal seedlings.

2. Experiments in growing seedlings under field conditions in Sal forests both in deep shade and in the open, the experiments being repeated for several years in order to obtain average results.

3. Experiments to determine the effects of dominant or limiting factors on seedlings grown in water cultures and pot cultures under control.

4. Experiments in the field to determine how far the limiting factors can be controlled by methods suitable for incorporating in a practical system of silvicultural management.

Field experiments conducted during the years 1909 to 1915 indicated that a layer of dead leaves on the soil surface is very injurious to the successful germination of Sal and to its early development; that drought is responsible for the widespread death and dying back of seedlings during seasons of scanty precipitation and that bad soil aeration causes large numbers of seedlings to die under shade during rainy seasons and many of the survivals to die during the dry season, due to their defective root development.

Based upon these results, the inference was drawn that the best method for regenerating Sal forests would probably consist in (*a*) clearing the surface soil of dead leaves and humus, (*b*) clear felling in strips and small patches, (*c*) artificial sowing in the cleared areas combined with weeding in the first year. In regions where the above were impracticable due to cost, it was pointed out that the number of Sal seedlings could be rapidly increased merely by the continued removal of the dead leaves by light leaf fires.

Field experiments conducted during the years 1915 to 1919 were of the same nature as those previously undertaken. As the system of regeneration suggested was contrary to existing ideas, it was deemed advisable to obtain further evidence. Studies were also made to determine the ideal seedling development for the locality and to elucidate the injurious action of a dead layer of leaves on germination and early growth.

A general idea of the detailed and comprehensive nature of this study is apparent in that the research was spread over a period of ten years and the report covers sixty-five pages of rather closely written descriptive matter and tables, accompanied by photographic reproductions. The facts brought out from the large number of experiments made are embraced in a summary of results under thirty-four headings, all directly bearing on factors influencing the germination of early growth of Sal in reference to the quick regeneration of Sal forests in northern India. It appears from these researches that the earlier silvicultural methods practiced in the regeneration of Sal forests will be materially changed.

There is great need in this country for ecological studies of the factors influencing the germination and early growth by many of our commercial species in order to discover a method of practice that will reduce the time now required for regeneration and in order to make regeneration more certain. The study of Sal conducted by the Forest Research Institute of India points the way by which much profitable agricultural research of an economic and practical nature might be undertaken with a number of our own species. J. W. T.

Precipitation and Growth of Oaks at Columbia, Missouri. By William J. Robbins, University of Missouri, Agricultural Experiment Station, Research Bulletin 44, August, 1921.

Huntington, Douglas, Brewster, Shreve, Stewart and other writers in this country and abroad have in recent years attempted to relate growth in individual trees and in stands to weather conditions. The author of the research bulletin under review has studied diameter growth in sixteen oaks growing in the vicinity of Columbia, Missouri, and has attempted to correlate growth with precipitation. For the most part the species upon which the study was based were *Quercus rubra* L. and *Quercus imbricaria* Michx., two of the most abundant oaks of the region. The measurements were confined to the stumps

of previously felled trees on the floor and sides of a small flat valley, through which ran a small stream, dry during a part of the summer. It is to be noted that the trees before felling were isolated in open stand, growing above a sparse undergrowth of shrubs or of grass.

Two methods were followed in making the measurements. In one a sheet of white paper was laid on the stump and marks thereon indicating the limits of each year's growth were made along the edge of the paper. Three such records were obtained from different radii on each stump. The sheets were later taken to the laboratory and the data worked up at convenience. In the other method followed, a ruler was laid on the stump along a given radius and the width of each ring noted and recorded in the field.

All the stumps measured were of trees that were approximately 100 years of age. Detailed studies were made on sixteen trees from which 3,500 measurements of individual rings were obtained. The data are presented in tabular form showing the average width of the rings for periods of years from 1830 to 1910. This table appears to show that there was an increase in the width of the annual rings with increase in the age of the trees up to about 100 years for the trees measured. Thus from 1830 to 1859 the average width of the annual rings was 0.052 inch; from 1860 to 1889, 0.106 inch; and from 1890 to 1919, 0.152 inch.

Although the author states that the growth in diameter of a given tree is the resultant of many factors, both internal and external, he is unable, from his data, to explain the increased diameter growth in the trees studied in terms of these factors separately considered.

The most striking fact brought out from the study of the data is the frequent occurrence of narrow rings alternating with one or several much broader ones. A table is presented which shows the following to have been years of relatively small growth: 1833, 1834, 1838, 1840, 1841, 1848, 1860, 1870, 1874, 1877, 1886, 1887, 1888, 1890, 1894, 1900, 1901, 1903, 1906, 1911, 1914, and 1918. The attempt by the author to correlate variations in the width of the annual rings with the length of the growing season, the dates of the last killing frost in the spring or the first killing frost in the autumn, met with little success. A comparison, however, of mean monthly temperatures with the diameter growth seemed to show that the temperatures of May and June vary inversely with the width of the growth rings. So also a comparison of precipitation with diameter growth show that in some years a drop in

the annual rainfall was correlated with a drop in wood formation, while in other years a decrease in precipitation was not accompanied by a corresponding decrease in wood growth. In some cases a low annual precipitation appeared to show its effect in decreasing the growth in the following year.

As annual precipitation measured from January to January does not correspond with the period of physiological activity in the tree's growth, the author attempted to correlate precipitation for groups of months with diameter growth and with somewhat better success, but even here unexplained irregularities are not infrequent. On page 8 it is stated that a low annual precipitation apparently shows its effect in the following year. Thus the small rainfall in 1910 and decreased ring growth in 1911. On the next page, however, data is presented to show that the precipitation of one year does not show its effect the following year. Thus the heavy precipitation in 1893 had no apparent effect in influencing the small diameter growth of the next year due to the low rainfall of that year.

The best correlation of rainfall with ring width was found in the comparison of the total rainfall in March, April, May, and June with annual ring width. According to the author ring width varies directly with the precipitation for the above months and inversely with the temperature for May and June. A table is presented showing this correlation. The sum of calculated ring width values over a period of thirty years, based on rainfall and temperature, was found to be 3.459 inches as compared with the observed values of 4.574 inches. The author by inspection introduces a factor which brings the calculated values more closely in agreement with the observed values. This factor he assumes to be an approximate expression of the normal growth tendency of the oaks under consideration. His conclusion is that the average ring width for the past thirty years in the oaks studied was largely determined by three variables, namely, the gradually changing factor which may be age, the rainfall for March, April, May, and June, and the temperature for May and June. He also concludes that variations in ring width from year to year were largely determined by variations in two factors, namely, the rainfall for the four months mentioned and the temperature for the two months mentioned above.

This investigation, although developing an ingenious method for correlating ring width with temperature and precipitation, cannot be accepted as final in its results and adds little to our present knowledge

of the subject. It appears reasonably certain to the reviewer that the slow growth in the trees studied during the early part of their existence argues their origin in dense stands when the individual stems were in keen competition for growing space. Later on, the stands becoming open, the individual trees were making their maximum diameter growth when approximately 100 years of age when they were cut. It is reasonably certain were the trees studied growing in closed stands when cut, rings width would not have shown a gradual increase by periods of years during the entire time covered. In other words, growth tendency is so subject to modification by various environmental factors whose effect cannot be separately determined, it is an extremely unsafe assumption to assign variations in average ring width at different periods in a given tree's existence, to age. Although the smoothed curve of the annual ring width expresses the growth tendency of the oaks considered under their particular environment, it would not likely express the same growth tendency were the oaks under another environment. J. W. T.

Growth of Oak in the Ozarks. By Frederick Dunlap. University of Missouri, Research Bulletin 41, pp. 28. Columbia, Mo., March, 1921.

Although Professor Dunlap is credited with being the author of this interesting bulletin—the swan song of the defunct Department of Forestry at the University of Missouri—he is at pains to explain that Professor Pegg is joint author. This work was originally his as indicated in the acknowledgment at the end. As written by him it contained much explanatory matter designed to make the results more readily understood by the layman. After Professor Pegg's resignation the manuscript was returned with a request to reduce it and make it a technical bulletin, and in doing so Professor Dunlap added his own name. Proof as submitted never showed any author's name, as this is added with title and cover page at the last minute.

This bulletin deals with the rate of growth of the four principal species of oak on certain poor soils in the Ozark region of Missouri. The species are black oak, black jack oak, white oak, and post oak. The study shows that the growth of post oak and of black jack oak is too slow to warrant their retention in the managed forest. Black oak grows more rapidly than white oak in the first century—at 100 years of age the former averages 15 inches d. b. h., the latter 10 inches d. b. h.

With black oak are grouped the closely related species such as red oak, Texan oak, and Spanish oak.

Diameter growth was studied by finding the relation between the radial growth during a given decade and the radius at the beginning of that decade. The first four tables show the diameter growth at breast height of each of the four species studied. The curves on which these tables are based are also given. The next four tables show the relation of age, height and volume to diameter at breast height for each of the four species.

The reviewer took one of these last tables—that for black oak—and prepared the following figures on current annual increment by Pressler's and Schneider's formulæ.[1]

D. b. h. outside bark	Age on stump	To grow last inch in diameter	Volume	Current annual increment	
				Pressler (curved)	Schneider (curved)
Inches	*Years*	*Years*	*Cubic feet*	*Per cent*	*Per cent*
1	9	9	....	....	....
2	17	8	.5	....	11.2
3	23	6	.7	12.8	9.9
4	29	6	1.4	11.1	8.6
5	34	5	2.4	10.5	7.4
6	39	5	3.8	8.9	6.4
7	44	5	5.8	7.6	5.4
8	50	6	8.2	6.3	4.6
9	56	6	11.0	5.4	3.9
10	61	6	14.3	4.7	3.5
11	67	6	17.7	4.1	3.1
12	73	6	21.6	3.6	2.8
13	79	6	26.0	3.3	2.6
14	84	5	31.0	3.0	2.4
15	90	6	36.6	2.8	2.2
16	97	7	42.9	2.5	2.0
17	103	6	49.6	2.2	1.9
18	109	6	56.7	2.0	1.7
19	115	6	64.0	1.8	1.6
20	122	7	71.5	1.6	1.5

It would seem that similar figures for the c. a. i. of the other species would increase the utility of this study.

The bulletin ends with a tally of the trees and of the volume yield on four sample plots as a test of the accuracy of the computed volume tables. The average error was found to be 3 per cent. A. B. R.

[1] See Recknagel, A. B., and Bentley, J., Jr., "Forest Management," John Wiley & Sons, N. Y., 1919. Articles 68 and 69, pp. 110-111.

Lignum Vitæ: A Study of the Woods of the Zygophyllaceae with Reference to the True Lignum Vitæ of Commerce—Its Sources, Properties, Uses, and Substitutes. By S. J. Record, Yale University, School of Forestry, Bul. No. 6; 48 pp. New Haven, Conn., 1921.

This bulletin consists of two parts, written, respectively, from the botanical standpoint and from the commercial standpoint, topped off with a summary and conclusions and an erudite list of references, all of it illustrated by plates.

In the first part it is made plain that lignum vitæ belongs to the family Zygophillaceae, which has but three tree genera: *Guaiacum, Porlieria,* and *Bulnesia*—all tropical. Of these the first alone is the true source of the lignum vitæ of commerce. It is distributed over the islands and coastal regions of tropical America. Most of the timber comes from Cuba, Haiti, San Domingo, Jamaica, and the Bahamas. At least six species are recognized. Of these *G. sanctum* is the only one found native in the United States, but, because of its small size, is not of great commercial importance. The wood of *G. officinale* is probably the chief source of commercial lignum vitæ, although this is not yet definitely ascertained.

The second part reviews the commercial range of lignum vitæ. Some idea of its importance may be gained by the fact that 2⅔ million dollars worth of lignum vitæ were imported into the United States in the past 20 years.

"Lignum vitæ is one of the heaviest woods in the world. The weight (oven-dry) per cubic foot of the heartwood is usually between 75 and 80 pounds. The wood has been an article of trade for more than four centuries. It was formerly supposed to possess remarkable curative powers but is now little employed in medicine. Its principal uses are for bearings (especially for lining the stern tubes of steamships), sheaves, caster-wheels, bowling balls, and miscellaneous articles of turnery. During the war there was an unusual demand for this wood in the shipbuilding industry.

"The properties which make lignum vitæ valuable are great density and hardness, extreme toughness, and resistance to wear. The large resin content of the wood acts as a preservative and a natural lubricant, thus making it especially adapted for service under water, as in the case of propeller bushings and water-wheel work.

"No wood has been found which is a satisfactory substitute for the more exacting uses to which true lignum vitæ is so eminently suited.

"Dealers have no difficulty in getting an abundant supply of genuine lignum vitæ logs. Although the more conveniently located timber has in many places been cut out, increased prices have made it possible to secure timber previously considered inaccessible. The supply appears adequate to meet the demands for a great many years."

The School of Forestry at Yale is to be congratulated upon its sixth bulletin in a series of marked merit. Professor Record, as the author, has shown ability for painstaking research. The publication is attractive, useful, and a permanent contribution to our knowledge of tropical woods. A. B. R.

PERIODICAL LITERATURE

SOIL, WATER, AND CLIMATE

Vegetation Limit in the Alps and Its Significance

The retrogression of the upper limits of vegetation in the Eastern Alps, and the decline or disappearance in many places of the dairy industry which formerly depended upon the high mountain pastures, is due partly, perhaps, to climatic changes, but the acts of man are more responsible. The cutting of the Alpine forests for their timber, and the burning of brush-covered areas in order to improve pasturage, exposed the Alpine meadows to the winds, with the result that grass and practically all other plant growth gradually disappeared. Overgrazing by cattle and, later, more serious overstocking with sheep, prevented reproduction of the trees which were needed to shelter the meadows, and also injured the forage cover, so that many areas which once supported large numbers of stock have become barren wastes. These conditions can be remedied only by establishing protective belts of brush and trees, which will be a long and costly task. W. N. S.

Hauber. *Der Rückgang der Vegetationsgrenzen in den Alpen und ihre Bedeutung für die Almwirtschaft.* Forstwiss. Centralbl., 42:436-443, 1920.

Temperature Observations, Forests of Norway, 1919

Fifteen stations have been installed for the purpose of closer study of the relation between air temperature and seed production along the northern timber line in Norway. It has been found by borings and silvical study that successful natural reproduction periods are about 100 years apart, not because the seed is produced so seldom but because favorable temperature conditions for blossoming and seed ripening require three seasons of relatively high air temperature. Dr. Hagem of the Bergen Experiment Station has found by testing pine seed from different parts of Norway, and that from the northern timberline included, that the latter is practically worthless and that a mean air temperature of at least 10.5° C. must prevail during the period of ripening. During some seed years the average temperature often falls below this in the northern section. J. A. L.

Krogness, C. *Om temperaturmaalingerne i skogsdistricterne i Nord-Norge sommeren 1919.* Tidsskrift for Skogbruk, supplement, 28: Nos. 9 and 10, 39-56, 1920.

SILVICULTURE, PROTECTION, AND EXTENSION

Parasitic Fungi

Specialization, or the act of specializing by parasitic fungi, is the result of cooperation between their individual capabilities and the nature of the locality, that is, of the host plant. However, they are so much more dependent upon their hosts, since they must not only derive water and mineral constituents, but also carbon compounds, from them and with reference to the latter, host plants exhibit the greatest variation. Combinations of carbon may be considered under three forms: (1) Protoplasm, with cell nucleus and chloroplasts; (2) cell sap with its free carbon compound contents; (3) cell-wall.

The cell-sap constitutes the most convenient source of nourishment for the parasites. The power of the parasite to attack the cell-sap is altogether dependent upon its ability to kill the protoplasm. It is well known, however, that the permeability of living protoplasm is secured by chemical action and the so-called life energy which enables a plant to withstand a fungous attack can be called "protoplasmic permeability." Insofar as "life energy" of a plant denotes rapidity of growth and normal anatomical development, the fact that sickly and weak plants are especially subject to attack is due to other causes. Slow growth leaves plants longer in the condition of young growth with greater sap content and incomplete development of the protecting cell walls; weak resin pressure in conifers affects parasites less than a vigorous exudation of this protecting medium which assists the host in combating both insects and fungi. It is evident that not all cell-sap possesses a like food value for fungous growth. Many poisonous elements in cell-sap are not capable of nourishing certain fungi; whether they are actually poisonous to the fungi is not definitely known.

Specialization is first brought about in the ability of the fungus to penetrate the cell-wall which offers the chief medium of resistance. The most difficult wall to overcome is the thin corky layer, the cuticula which frequently covers the outer side of epiderminal cells. Very frequently the cuticula offers a poor place for the germination of spores because is may shed dewdrops and rainwater. It is also, more or less, insusceptible to chemical action. Entrance in some cases is effected through mechanical boring with a sort of needle appendage or with the help of chemotropic stimuli. Entrance is often effected through the stomata.

Among others, one of the most important fungi which brings about the destruction of forest trees chiefly because of its ability to decompose

cellulose, is Botrytis vulgaris Fr. The author made a very complete study of this fungus and describes a few of the most important results.

The infection of plants by Botrytis spores is uncertain in drops of pure water, a condition which affects probably all wound parasites. Infection is first secured when the parasite secures strength to attack after receiving nourishment from dead organic matter, as is the case in the resultant exudation from wounds. Infection is always secured on wounded areas, and as far as the interior character of plants is concerned, Botrytis is onmivorous.

The variations in the effect of illness in different plants is due to interior characteristics of the plants. Under these characteristics may be considered the water content, chemical composition, and aeration of the leaves. In a sickly leaf, the infiltration in the intercellular spaces cuts off, in part, the ventilation. If the epidermis happens to be thick with few stomata and covered with waxy surface, the growth of Botrytis is slowed up since it is extraordinarily air-requiring and in such succulent plants as Sedum maximum and others it makes slow progress. In thin, succulent leaves with numerous stomata, infection progresses rapidly; in dry leaves, poor in sap, as Quercus fagus, infection progresses slowly. It is not established that certain chemical elements occurring in concentrations within the leaves check the growth of Botrytis. Where this was apparently the case, the cultures showed that the fungus was not affected by these bodies. Additions of small amounts of amydalin and tannin had no effect.

The anatomical investigation of diseased areas proved that chloroplasts and nucleus very often are intact and that the cell-wall is not always decomposed. The cuticula remains undisturbed.

Under the influence of the fungus the cellulose of the parenchyma cells is affected as follows:

DECOMPOSED IN—	PARTLY DECOMPOSED IN—
Corylus tubulosa.	Asarum europaeum.
Quercus sessiliflora.	Saponaria officinalis.
Ulmus montana.	Prunus padus.
Urtica dioica.	Sorbus torminalis.
Rumex obtusifolius.	Sorbus aria.
Ranunculus repens.	Rhamnus frangula.
Syringa vulgaris.	Ligustrum vulgare.
Fraxinus excelsior.	Viburnum dentatum.
Glechoma hederacea.	Vibrunum lantana.
Stachys silvatica.	
Sambucus nigra.	
Populus alba.	

NOT DECOMPOSED IN—

Rumex acetosa.	Vitis vinifera.
Mahonia aquifolium.	Tilia parvifolia.
Platanus occidentalis.	Dierrilla floribunda.
Prunus laurocerasus.	Viburnum opulus.
Robinia pseudoasacia.	

Botrytis vulparis, from the above table, has the ability to separate the cellulose of the leafy paranchyma of plants of the most diversified families. The variations encountered may be due, in part, to differences in nourishment. Behrens infers, from his investigations, that the parasite regulates the development of the cellulose enzyme, when no sugar is present for its nourishment.

The changes which the extract or poison from the fungus produces in the tissue of the host, are loss of turgor and death of cells, among others through plasmolysis, also separation of cells from each other. That the poison produced is not oxalic acid is evidenced by the fact that oxalic acid, aside from the killing of the cell, creates an entirely different set of reactions; and is also poisonous itself to the fungus, in which, no doubt, as in higher plants, its production is self regulated.

It is often wondered why mosses, which live in a damp atmosphere with little or no air movement, do not mold. This has been previously explained as being due to the "life energy" of mosses; but the real explanation is that the fungus has no enzyme which can to any extent decompose the cell-membrane and proto-plasm of the mosses. In other words, the fungus is dependent for nourishment upon the cell-sap and this is made available only after the leaf has died.

Specialization in Botrytis is regulated by moisture in the air and dew which assist in the germination of the spores and the death of plant parts through frost or old age, gives the fungus an opportunity to develop on dead tissue and gain its parasitic attacking strength.

The author found not less than 84 plants out of 121 immune to infection in the unwounded upper side of the leaf. Of these plants, many are characterized by a flat, shining, smooth, waxy epidermis; for instance, water plants, as Alisma plantago, Nuphar luteum, and land plants, as Pirus communis, Crataegus oxyacantha, etc.

The 34 species which proved themselves as susceptible in the unwounded state as when wounded, had thin epidermal outer walls and no waxy covering so that they offered little mechanical resistance to the attack of the fungus. To these belong the following:

SOFT.	FAIRLY SOFT.
Juglans regia.	Salix—species.
Robinia pseudoacacia.	Amelanchier rotundifolia.
Begonia sp. (occasionally immune).	Parthenocissus quinquefolia.
Sambucus nigra.	Rhamnus frangula.
Symphoricarpus racemosa.	Staphylea pinnata.
Lonicera—species.	

HAIRY.	HARD.
Urtica dioica.	Prunus arium.
Ulmus montana.	Prunus cerasus.
Ranunculus repens.	Prunus domestica.
Pelargonium zonale.	Prunus padus.
Oenothera biennis.	Sorbus aucuparis.
Glechoma hederacea.	Sorbus aria.
	Sorbus domestica.
	Cornus sanguinea.
	Vaccinium myrtillus.
	Aristolochia sipho.
	Viburnum lantana.
	Plantago major.

It is not certain that some of the hard-leaved species were not attacked through unnoticed wounds. In general it may be said that our knowledge of the fundamentals of choice of host plants by parasitic fungus is not very extensive.

J. ROESER.

M. Busgen. *Omnivorie und Specialization Bei Parasitischen Pilzen.* Zeits. fur Forst und Jagdwesen, 51:144-153, 1919.

Chermes Galls on Conifers

This leaflet describes in popular terms the various species of Chermes affecting conifers in Great Britain. Two hosts are necessary, as a rule, in the complete life cycle of the insects, such as spruce-larch, spruce-silver fir, etc. The spruce generations are gall-forming but on the secondary hosts no galls are produced. Injury to spruce under 4 years is rare. On older trees it is of comparatively small importance to the individual but considerable in the aggregate. Injury to larch, pine, silver fir and Douglas fir may take place in the nursery due to destruction of the foliage and weakening of the plants. Remedial measures consist in fumigation of nursery stock and spraying with paraffin-soft soap, or nicotine-soft soap emulsions, or dipping in soft soap emulsion, for which formulas are given. C. J. H.

Chermes Attacking Spruce and Other Conifers. Forestry Commission, Great Britain. Leaflet 7, 7 pp., 4 figs., 1921.

Root Rot of Conifers

A popular discussion of *Armillaria mellea* on various conifers in Great Britain is given. It is stated that probably no species of conifer is immune. The usual symptoms are briefly described. The most susceptible confers are said to be Corsican pine, Weymouth (white) pine, Scots pine, and Sitka spruce. Deodar is often killed. Norway spruce is not very susceptible when young. Larch is often very resistant. Douglas fir is probably the least susceptible. The disease is chiefly to be feared where oak and beech have been removed and conifers planted. Destruction of sporophores is rcommended as well as trenching isolated infections. The trenches should be about 9 inches deep and kept open. Small infected plants should be removed and replaced with broadleaf species. Grubbing stumps is said to be the best method of combat, but expensive.

C. J. H.

Root Rot of Conifers. Forestry Commission, Great Britain, Leaflet 6, 4 pp., 2 figs.

The Cost of Forest Fire Protection

Statistics of past and present protection, stand, and forest area are given, together with a comparison of growth and cut. Also includes figures of the number, acreage, and loss from fires. The cost items of a fire protection system are outlined, and indicate a rate of 1.8 cents per acre, or $0.0075 per $100 valuation.

J. K., Jr.

Peters, J. G. Lumber, 878:30g-30h, 1921.

Conifer Heart Rot

The root and basal trunk rot due to *Fomes annosus* is discussed. It is said to be the most frequent cause of heart rot in various confers in Great Britain. When old trees are attacked they are seldom killed. Young trees, however, rapidly succumb in a manner similar to those attacked by *Armillaria meallea.* The fungus enters underground parts through wounds or dead roots and the rot is frequently unsuspected until thinnings are made. If the infection is quite general it is recommended that the crop be utilized at an early opportunity. Blanks due to the fungus should be filled in with broadleaf species, which are free from attack. Larches and spruces suffer most, but Douglas fir is not seriously affected except when young, when

it, together with Corsican and Scots pine, is particularly susceptible. Young plants attacked by the fungus should be grubbed up and burned. The usual distinguishing features of the rot and fructifications are noted. C. J. H.

Conifer Heart Rot. Forestry Commission, Great Britain, Leaflet 5, 5 pp., 3 figs., 1921.

Crown Form and Tolerance

Mayr's law, that a given species needs less light in a warmer climate, and more light in a cool climate, is not entirely true. Several trees, notably the Scotch pine, spruce, larch, and oaks, increase in tolerance eastward and northward from western Germany, and are also more tolerant at the higher elevations than on the plains. There appears to be a fairly constant relationship between tolerance and form of crown, not only for the species mentioned but also for others, such as the birch, aspen and Austrian pine. Toward East Prussia and western Russia the crowns become narrower, the trees stand closer together, their boles are more cylindrical, and height growth is more rapid. Moreover, in contrast to conditions prevailing in western Germany, natural reproduction is abundant under the shade of the old stands. W. N. S.

Rubner. *Baumkronenform und Schattenfestigkeit.* Forstwiss. Centralbl., 42:249-258, 1920.

Nitrogen Fertilizer Experiments with Spruce

Summarizes the results of experiments in fertilizing spruce nursery stock, carried on during the 11 years 1907-1917. Full fertilization (potash, basic slag, and nitrates) applied to 2-year transplants resulted in greater height growth than in the case of those which were fertilized only partially (nitrates only) or not at all, and the effect persisted, although to a less degree, with another application of the fertilizers when the trees were transplanted at 4 years of age. On the other hand, the fertilized transplants, set out in the open without fertilizer when 4 years old, grew more slowly than those which had not been fertilized in the nursery bed, and at the end of the eighth year had lost their early gains and were shorter than the partially or not fertilized ones. Relative weight of root-systems was less in case of complete fertilization, but needle weights were about the same. The foliage of fertilized plants was

deeper green, but apparently no healthier than that of the others. Transplanting reduced the height growth of both fertilized and unfertilized plants. The conclusion is that fertilization of young spruce with nitrates alone is not profitable, but that complete fertilization with nitrates and the other fertilizers is advantageous in cases where tall planting stock is desired at an early age. The author does not entirely agree with results obtained by Möller and Albert. W. N. S.

Helbig, Maximilian. *Zusammengefässte Ergebnisse der Karlsruher Stickstoffüngunsversuche mit Fichten, ihre Bewertung und Stellung zu fremden Versuchsergebnissen.* Forstwiss. Centralbl, 42:262-267, 1920.

A Trial of Broadleaf Selection Forest

While coppice under standards is undoubtedly the most widely used method of treatment in France, it has long been recognized that it falls far short of producing the maximum amount of timber. The classic method of converting such stands into high forest is too slow, too complicated, and involves too great a sacrifice of present returns to be practicable. A more feasible method, which is already virtually in use in many places, is to establish by relatively frequent improvement cuttings a selection high forest in which the number of trees is inversely proportional to their diameter. This method, with cuttings about every fifteen years, makes it possible to favor the most promising seedlings and saplings, to remove mature trees most advantageously, and to establish a high forest with a good yield of timber without sacrifice of present revenue. Conditions vary so widely that no set rules for applying it can be laid down, and a thorough knowledge of silviculture is necessary to use it to advantage. S. T. D.

Schaeffer. *Un essai de futaie jardinée feuillve.* Bull. Trimest. Soc. Forest, Franche-Comté et Belfort, 13:239-247, 1920.

Suitability of Piscea Pungens in Forestry

The Colorado blue spruce plantations in Norway show promise that this tree will help solve the problem of extending timberline northward and upward where the native trees do not thrive. It may also be used to advantage on the poorer wind-swept cities near the coast. The plantations are now from 12 to 20 years old and are everywhere on precarious sites superior to the other species. J. A. L.

Ruden, Ivar. *Picea pungens. Dens anvendelighet i vort skogbruk.* **Tidsskrift for Skogbruk**, 29:39-47, 1921.

Clear Cutting in Prussian Private Forests

The proposed law forbids clear cutting of more than 1/60 of the area of a forest unit, or excessive thinnings, without special permit. It applies to high forests or similar forests, but not to coppice forests. All privately owned forests are subject to this law, except those managed cooperatively, which are already provided for. This law is intended to prevent forest devastation, which is threatened, especially near the towns, until the proposed new law regarding forest culture can be passed and made effective. At present there is no legal way to prevent devastation of private forest lands in Prussia.—Comments on the law, by *Dr. Bartog,* are appended. W. N. S.

Anonymous. *Entwurf eines preussischen Gesetzes über Kahlschläge **in** Privatwaldungen.* Deutsch. Forstztg, 36:39-41, 1921.

Generation of the Weevil

Investigators in different regions have disagreed as to the length of generation of the weevil, some finding a period of 15 months from egg to imago (2-year generation), others 12 months (1-year generation), and others 3 to 5 months (2 generations per year). All three positions are supported by reliable data. The difference appears to be due to climatic differences. It is suggested that in regulated forests, where the cutting is more or less concentrated in space and season, the emergence of the beetles is likewise concentrated and more likely to prove harmful, than where, as in a virgin stand, the beetles come out at various times through the year.

W. N. S.

Escherich, K. *Die Generationen des grossen braunen Rüsselkäfers* (***Hylobius abietis***). Forstwiss. Centralbl., 42:425-431, 1920.

Pine and Spruce Plantations

The arrested development of pine and spruce stands, common in certain parts of the Upper Palatinate, is attributed to plant and animal enemies, principally the heather, which temporarily suppresses the young trees, the blight, and various leaf-rollers. Various methods of improving soil conditions have been tried, in order to keep down the heather and enable the trees to resist their other enemies. The best results were obtained by grubbing out the heather, or by sowing broom, larch or possibly *Pinus strobus* among the young

trees. No benefit resulted from loosening the soil by blasting, or from application of various fertilizers, or from intersowing of lupine, pitch pine, or jack pine, or from modifying the silvicultural system so as to give the advance reproduction a start over the heather. W. N. S.

Meissner. *Versuche zur Hebung von Föhren und Fichtenkrüppelkulturen.* Forstwiss. Centralbl., 42:315-329, 1920.

Norwegian Forestry Association

The author sums up the results of an inspection trip of the forest plantations on the west coast of Norway near Stavanger and Bergen. These plantations are up to 50 years old and consist of Norway spruce, Scotch pine, Douglas fir, noble fir, oak, and birch. The soil is generally excellent for reforestration and the local sentiment in favor of this work very good, thanks to the energetic leadership of a few men. Private owners are required by law to cut according to the State's dictum and to replant denuded tracts. J. A. L.

Heiberg, Axel. *Det Norske Skogselskap.* Tidsskrift for Skogbruk, 28:187-200, 1920.

MENSURATION, FINANCE, AND MANAGEMENT

Loss of Future Value and Forest Reparation

Official instructions for determining the reparations due from Germany as a result of forest destruction in France provide for including in the estimated damage the loss of future value in the case of trees or stands destroyed prior to the normal age of exploitation. A simple method of determining this loss without the use of compound interest formulas is as follows: Estimate the volume, and from this the value, of the trees on the basis of its diameter in 1914 and of its normal diameter at maturity (assumed to be 40 cm.). The difference between these values gives the gross loss in future value; and this gross loss divided by the ratio between the value at maturity and the value in 1914, gives the net loss. While this method avoids any determination of the two unknowns rate of interest and number of years to maturity—in the usual compound interest formula—it gives precisely the same result, since the ratio between the value at maturity and in 1914 $\left(\frac{V^1}{V}\right)$ is equal to $1.0p^n$ for the diam-

eter selected. It is inaccurate to use a single rate of interest as applying to the rate of yield of a tree or stand throughout its life since the rate varies greatly according to such factors as its age, size, and estimated maturity. Thus, by the method just described, assuming that a tree increases 5 cm. in diameter every ten years and that its diameter at maturity is 40 cm., the future yield in the case of oak is found to vary from 6½ per cent for trees 15 cm. in diameter to 3 per cent for those 35 cm. in diameter. To illustrate the importance of including the loss of future value in reparation calculations, a typical case is cited in which this value amounted to 30 per cent of the value of the high forest and to 62 per cent of the value of the young reserves. S. T. D.

Raux, Marcel. *Le calcul de la perte de valeur d'avenir et la question des réparations forestières.* Rev. Eaux et Forêts, 59:1-10, 1921.

UTILIZATION, MARKET, AND TECHNOLOGY

Western Wood Oils

Several species of coniferous woods plentiful in Idaho, and one species, Port Orford cedar, from Oregon, were distilled to determine the yields of total oil and the oils were tested for flotation value. The table gives the yields of total oil obtained by the distillation of the local species. No figures are given for the yields from Port Orford cedar.

Species	Yield of oil per cord gallons
White fir	10.6
Cedar	11.0
Larch	12.2
Douglas fir	13.4
Lodgepole pine	17.6
Western yellow pine	55.0

The high yield in the case of western yellow pine was due to the use of stumpwood instead of cordwood as was the case with the other species. The oils were tested for flotation value on lead and zinc ore and on copper ore, and were divided into three groups depending on their value for flotation work. The first group consists only of Port Orford cedar, the second group contains lodgepole pine, red fir, and larch, which are classed as good flotation agents, while the last group, classed as "fair," contains western red cedar, yellow pine, and white fir. The reviewer does not claim to be a metallurgist, but from the detailed figures of the flotation experiments it does not seem that this

classification is justified. It would seem to correspond more nearly with the numerical data to class Port Orford cedar, western red cedar, lodgepole pine, and red fir oils as "good" flotation agents and the other three as "fair." There seems to be nothing in the numerical data to show that Port Orford cedar is better than the other oils, and western red cedar is clearly better than larch, although it is not classified as such in the conclusion. Several oils are included in the flotation tests of which there is no description in the first part on the production of the oils. This is confusing as well as is the use of terms like "creosote" without further description of how the material was prepared. The writers apparently were in ignorance of the fact that "pine oil" is the well known and well recognized trade name for a heavy oil contained in comparatively large quantity in the wood of very resinous longleaf pine. The use of the term "pine oil" to describe the total oil obtained by the destructive distillation of western yellow pine is therefore confusing. Another example of lack of information on wood distillation is shown in the statement that the type of retort used in the experimental work is extensively used in commercial plants throughout the Southern States. As a matter of fact, this type of retort in which the distillation is accomplished by means of the circulation of hot oil through a coil of pipe inside the retort has never been used in a commercial plant. The conclusions of the reviewer would be that the yields of total oil from the woods distilled were disappointing in comparison with the yields obtained by commercial distillation plants using longleaf pine, while the flotation values of the oils were surprisingly high. **L. F. H.**

The Availability of Western Wood Oils for Flotation Concentration. By J. W. Cook, Henry Schmitz, and Louis A. Grant, University of Idaho, Volume XVI, No. 134.

Caterpillar Tractors in Forest Exploitation

Experiments in November, 1920, in the forests of Haguenau (Bas-Rhin) with a small, 35 horse power caterpillar tractor weighing 660 pounds showed that it can climb without effort slopes of 35 to 40 per cent and can cross swamps, ditches, and small streams. It maneuvers rapidly in pole stands and does little or no damage to the soil, but is destructive to seedlings in areas under regeneration. The tractor is able to haul easily three pine logs with a total volume of more than 140

cubic feet, but is not recomended for extracting stumps. It fells 120 year old Scotch pine at the rate of 350 cubic feet of timber and 1.5 to 2 cords of stump wood per hour, but is not satisfactory for felling hardwoods. It is of no interest in regions where logging is easy and not expensive, but can be used to advantage for removing logs in mountainous country without good roads or in other regions difficult of access or where team transportation is very costly. Its usefulness in felling coniferous trees is limited to cases where it is desired to extract the stumps, as is usually the case, and then only when the labor of woodcutters is particularly expensive. S. T. D.

Huffel, G. *Emploi de tracteurs à chenilles dans les exploitations forestières.* Rev. Eaux et Forêts, 59:40-42, 1921.

Chestnut Wood Tannin

This article gives a good general description of the production and use of the tannin of chestnut wood. Of special interest to the forester are the statements in regard to the effect of age of the tree and locality on the tannic content. It is stated that trees about 15 years old and six inches in diameter show a tannic content of approximately 7.83 per cent, whereas trees 90 years old and 30 inches in diameter show a tannin content of approximately 9.72 per cent. The tannin content of the wood in the southern part of the belt is approximately 10 to 11 per cent, whereas wood grown in the north or even in the higher altitudes shows approximately 7 to 8 per cent tannin.

L. F. H.

Chestnut Wood Tannin. Robert W. Griffith, Journal of American Leather Chemists' Ass'n., June, 1921.

Oak Wood and Oak Wood Extract for Tanning

Production of tannin from oak wood began about 1883 in Slavonia and Croatia, developed later in France and North America, and during the war was tried in Germany. Results of analyses are given, which show that the tannin content increases with age of the tree, and is greatest in the lowest part of the bole. Sapwood contains very little tannin, while the greatest amount is in the outer layers of heartwood. Young trees (under 20 years) contain too little tannin to be worked profitably. Tannin content of at least 5 per cent (air-dry weight, moisture content about 14.5 per cent) is necessary for profitable operation, but the amount present

varies from about 1 per cent in young sprouts, to 13 per cent, rarely exceeding 9 per cent. The method of making the extract is described, and compositions of various extracts are given. Oakwood extract, which is different from oakbark extract, is very similar to chestnut wood extract, and gives about the same results. It is generally used in combination with chestnut, quebracho, or spruce extract.

W. N. S.

Passler, Johannes. *Die Bedeutung des Eichenholzes in gerberischen Beziehung und die daraus hergestellten Eichenholzauszüge.* Forstwiss. Centralbl., 42:241-249; 306-314, 1920.

Use of Wood in the Automotive Industry

On the average the bodies of automotive vehicles are estimated to require 125 board feet of rough lumber per machine. The estimated total consumption for 1920 is thus 280,125,000 board feet. Allowing for additional consumption in wheels, the quantity becomes 500,000,000 board feet. An additional amount is used in crating of about 35,000,000 board feet. The woods usually used in body making are hard maple, soft maple, ash, oak, elm, beech, birch, sycamore, gum, poplar, cottonwood, basswood and yellow pine. Grades of No. 1 and No. 2 common are ordinarily used.

J. K., Jr.

Anonymous. Lumber, 871:27-38, 1921.

Exportation of Firewood and Charcoal

At its annual meeting in August, 1920, the Forestry Society of Franche-Comté and Belfort adopted a resolution asking the Government to remove the prohibition on exports of firewood and charcoal because of the fact that in eastern France available supplies of these were considerably in excess of local needs. The Assistant Secretary of Agriculture replied that while it was impossible to alter present restrictions immediately because of the great need of France for fuel of all sorts, he would do what he could to find a market for firewood and charcoal from this region, and that where production remained in excess of consumption he was inclined to look favorably upon permitting such exports of these materials as might appear justified.

S. T. D.

Anonymous. *Exportation des bois de feu, et du charbon de bois.* Bull. Trimest. Soc. Forest, Franche-Comté et Belfort, 13:258-260, 1920.

A Rational Forest Utilization

The author lays stress on the fact that Norway will always receive much revenue from her forests, that the safest way of safeguarding the forests is by education of the people, by accumulation of fundamental knowledge, and until this is assured there must be Governmental regulation and supervision. The office of Herred-Forrester has been instituted to meet this need, to see that the laws are enforced, that no one but those who know best prescribe the cuttings, that capable men are put in charge, and that the right kind of information is gathered. About one-half of the country has now accepted this measure. J. A. L.

Opland, Evenby J. *Herredsskogmesterinstitutionen og dens betydning for et rationalt skogbruk.* Tidsskrift for Skogbruk, 28:210-218, 1920.

Ordinary Wood Compared with Plywood

The tensile strength of wood may be 20 times as great parallel to the grain as perpendicular to the grain, and its modulus of elasticity from 15 to 20 times as high. The shearing strength perpendicular to the grain is much greater than parallel to the grain. The shrinkage from green to oven dry condition across the grain of a flat sawed board is about 8 per cent, for a quarter sawed board 4½ per cent, and parallel to the grain practically negligible. The purpose of plywood is to meet these deficiencies by cross-banding so that the properties of the built-up wood are approximately equal in two directions, both parallel and perpendicular to the grain. J. K., Jr.

U. S. Forest Products Laboratory, Madison, Wis. Lumber, 871: 49, 1912.

Eucalyptus Lumber Not Yet Established

The planting of eucalyptus in southern California was boomed in 1907 to 1910. There are said to be something like 300 species of the genus now growing in that region. It grows rapidly, especially during the first three or four years, and on the average reaches a usable size in 15 to 30 years. One of the chief difficulties in making use of the lumber is its unusual inclination to curl and warp, and the exceptional difficulty of curing it satisfactorily. Its most general use is for firewood, but it is also being employed in the manufacture of farm implements, wagon

parts, tool handles, and insulator pins. In California "gum" is the usual term for eucalyptus, and as a result many homes are finished in what is supposed to be eucalyptus but, as a matter of fact, it is one of the gums usually (*Liquidambar*) of the southeastern United States.

J. K., Jr.

Byers, Charles Alma. Lumber, 878:21-22, 1821.

Crises in the Timber Market

Discusses the relation of the timber market to general economic conditions, and traces the fluctuations in timber imports and in timber prices in the important German states, in relation to cycles of general prosperity and depression. This relationship began with the development of a world trade in timber, in the 1860's. Timber has certain advantages over coal, iron, or wheat, as an indicator of economic conditions, because coal and iron production and prices, being manipulated by syndicates, do not respond readily to changes in the ratio of demand to supply, while wheat production and prices depend very largely on crop conditions and to some degree upon the tariff. Timber does not have to be marketed if conditions are unfavorable, except in certain cases, such as forced cuttings due to wind or other damage.

W. N. S.

Rubner, K. *Die Krisen am Holzmarkt.* Forstwiss. Centralbl., 42:353-360; 405-415, 1920.

NOTES

Court Decision Definitely Establishes Town Liability

The town firewarden system is the foundation for the protective organization in most of the older States in the East. At first it was the original and only organization and, as such, functioned very poorly or not at all. Subsequently, the States have superposed a State district supervisory organization, augmented by lookout and patrol. As thus extended, centralized, and made responsible the organization functions very well. Now and then, however, difficulty is encountered where certain towns persist in shirking their responsibility. A recent decision by the courts in Maine should serve as an object lesson to towns of this sort and generally strengthen the effectiveness of the whole protective organization.

In the particular case in question, one of the town selectmen, and who by virtue of this office is a town firewarden, had knowledge of the existence of a forest fire within the town but failed to take the necessary action to secure its suppression. As a result, one of the residents of the town suffered considerable damage to his property, brought suit against the town for negligence, and was awarded the verdict. The court in this case declared that "discovery of the existence of such a fire (when generally ravaging property or threatening havoc) by one of the selectmen is equivalent to discovery by all the selectmen within the same jurisdiction."

"The discovery of which the statute speaks is not limited to direct discovery. The discovery there spoken of means when a selectman, or a forest fire warden, shall have found out, either by evidence or by evidential facts leading to actual knowledge on his part, that there is a ravaging or threatening forest fire; when he knows, or, what in law and reason is the same thing, when he ought to know, of the existence of that kind of a fire—negligence on his part may impose liability upon his town."

The court "further found that that warden was guilty of negligence in not foreseeing to reasonable degree the potentiality of the fire that he left smouldering; in not foreshadowing a probable result of its flashing up; in not reasonably guarding against the danger it could do."

L. S. M.

On the Liability of Tree Seeds After Storage for Ten Years

In the autumn of 1910 seeds from each of thirty species of forest trees were prepared for storage and placed in fruit jars and the covers loosely screwed in place. The jars with their contained seeds were kept until the spring of 1921 on the window sills in a basement laboratory in Marsh Hall, Yale School of Forestry, where they were exposed to the air and light. The windows faced the west and in the late afternoon the jars were in part exposed to the direct rays of the sun. The summer temperature and humidity were approximately that of the outside air. In winter the temperature varied from 40° to 78° F., the temperature of a furnace heated building. The humidity was considerably lower than that of the outside air.

In May, 1921, samples of 200 seeds each were removed from the jars and sown in carefully prepared and protected seed-beds in the School of Forestry nursery and the progress of germination and early growth noted.

The following table gives the list of species and the tree per cent obtained in 1921 over a period of five months. The term "tree per cent" as here used, is the actual percentage of seedlings to seeds sown that appeared above the surface of the soil.

Species	Tree per cent in 1921	Species	Tree per cent in 1921
Abies fraseri	0	Pinus coulteri	0
Betula alba	0	Pinus divaricata	13
Betula papyrifera	0	Pinus ponderosa	0
Catalpa kempheri	0	Pinus ponderosa	3
Chamæcyparis lawsoniana	0	Pinus sylvestris	0
Cladrastis lutea	0	Pinus attenuate	69
Cupressus arizonica	13	Pinus massoniana	0
Cupressus goveniana	7	Pinus rigida	27
Cupressus macrocarpa	14	Pseudotsuga mucronata	0
Fraxinus oregona	0	Robinea pseudacacia	21
Koelreuteria paniculata	15	Staphylea trifolea	0
Morus alba	0	Sequoia sempervirens	7
Picea sitchensis	0	Thuja plicata	0
Picea canadensis	0	Tsuga heterophylla	0
Pinus echinata	6	Tsuga mertensiana	0
Pinus austraca	3		

An interesting result of these tests is out of thirty species of coniferous and hardwood species selected almost at random ten species, or one-third of the whole, contained viable seeds after storage for ten years in unsealed cans subjected to normal laboratory conditions as to temperature and humidity.

J. W. T.

We are asked to state that the publication of "American Forest Regulation," by T. S. Woolsey, Jr., and Prof. H. H. Chapman, will not come out before January, 1922.

The Philippine branch of the United States bureau of foreign and domestic commerce is gathering all data and information pertinent to the possibility of manufacturing paper in the Islands, according to an advice received from Manila. Information is also being sought regarding the possibility of obtaining large supplies of coir (coconut husk) used for the manufacture of roofing and water-proofing materials. It is said that the coir can be pressed into bales and shipped to the United States in the rough, where it is digested with caustic soda and torn into fiber. All this information, adds the advice, is being sought in the interests of a large and important manufacturer in the United States.

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The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

SUSTAINED ANNUAL YIELD AS A NATIONAL POLICY OF FORESTRY

A DISCUSSION IN SUPPORT OF PROFESSOR ROTH'S PLAN OF NATIONAL REGULATION OF FORESTS, WITH A BRIEF EXPOSITION OF THAT PLAN

BY RUSSELL WATSON

Assistant Professor of Forestry, University of Michigan

The purpose, ostensibly at least, of all present national policies of forestry is to insure to the people and to the industries of the nation a continuous and adequate supply of wood products suitable for their needs, and at fair prices. Since it is certain that severe timber shortage will come in perhaps 50 years, national policies of forestry should have as their objective means of lessening this shortage.

Other matters of forestry which sometime enter into discussion, such as protection of waterways from floods by means of forests, value of the forest for recreation, use of lands otherwise idle, etc., are comparatively of minor importance here. Furthermore it is certain that proper attention to these matters will result naturally if the prime purpose is accomplished.

This article is premised upon the belief that the cure for our forest ills lies in Federal control of forests.

An attempt is made to help find some light on this question: If Federal control of forests should be obtained, what steps should first be taken to secure the end desired, the end desired being a continuous and adequate supply of forest products. To do this, this paper has four major expositions, as follows:

1. To show that regulation of the amount of the cut of our forests rather than silviculture or protection is the most feasible method of insuring a continuous and adequate supply of wood, and is the best scheme for tiding over the period of timber shortage.

2. To indicate that fire protection and good silviculture are very difficult of accomplishment, if indeed not impossible in many regions, without sustained forest business such as will result from continuous forest production of the property.

3. To point out that taxation of private timber lands can be satisfactorily arranged only when the property returns are annual and approximately equal in amounts, as in sustained annual yield.

4. To summarize and to point out briefly the value of Professor Roth's plan of regulation of the forests of the United States. This plan calls for feasible and satisfactory working plans for all forest properties. If any owner does not prepare a working plan, a mandatory form of selection cutting with 20-year period of return is imposed. In either case the Government stands ready to purchase the land if the owner desires.

WHY CONTROL THE AMOUNT CUT FROM THE FORESTS

To get the forest lands of the United States, excepting those in the Far West and parts of the South, into satisfactory timber production, must take at least a hundred years of the most energetic and sustained effort. It is not conceivable that we will actually begin a rehabilitation of our devastated forests on the scale necessary to bring them into good production, within many years (twenty-five or thirty). As a result the control of the cut on the remaining virgin forests of the West is of the greatest importance.

It should be remembered, also, that even with the best timber production possible on all the forest lands of the country, no more timber can be produced than will be needed by the people and the industries.

At the present time the growth needed to replace our destroyed forests has not even started. There is a total of about 85,000,000 acres of land, once forested, now so ruined from fire and lumbering that merchantable trees only will come again onto the land, within reasonable time, by reforestation. There is also a matter of 250,000,000 acres of land lumbered over, and some of it burned over (mostly in New England and the Southern Appalachian Mountains) which supports a volunteer growth of poor timber trees intermingled with those poorest trees left by the lumberman—a forest usually poorly stocked with undesirable tree species which most certainly is not producing more than 30 per cent of the timber that it should.

TABLE 1.—*Estimate of Age Class Conditions of Forests of the United States.*

Based on U. S. Forest Service report in response to Senate Resolution No. 311, June 1, 1920. Age classes = 20 years. Rotation (Natural) = 200 years.

Acres											
	Age-class number										
		1	2	3	4	5	6	7	8	9	10
	Age in years										
	Bare land	1-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200
	Areas of each class in millions of acres										
Virgin forest, 140 million acres..	0	14	14	14	14	14	14	14	14	14	14
Saw timber areas—growing—120,000 acres................	0	25	25	20	10	10	10	5	5	5	5
Cordwood areas—130,000 acres..	0	50	50	15	5	5	5	..	..	..	..
Bare land—not restocking—80,000 acres.................	80	..	..	..	..	..	..	..	..	..	..
Total—470 million.............	80	89	89	49	29	29	29	19	19	19	19

This should be, if regulated on 200-year rotation, as follows:

	2.3	47	47	47	47	47	47	47	47	47	47

The present condition of age classes is, therefore, wrong now as follows:

	+77	+42	+42	+2	—18	—18	—18	—28	—28	—28	—28

The data in Table 1 indicate that we now have (on 200-year rotation):

1. Thirty-three times as much bare land as we should have.
2. Double the area of 1-40 year old stuff that we should have.
3. Of stands 40-60 years old, we have about the correct amount in area, but these stands are notoriously poor of condition.
4. Serious deficit in material over 60 years old.
5. About 160 million acres or over 34 per cent of total area in bare land plus stuff under 40 years old, and this area growing at the rate of about 5 million acres more each year.

Table 1 on page 819 by Professor Roth is of interest here. It considers the United States as a whole as a forest property under management, and indicates convincingly the condition of our forests in regards to age-classes. It is noticed that age classes from 0-40, and of mature timber, are well represented; but that the ages in between, which should be ripe for the ax when the older mature timber is cut, are conspicuously small in area covered. The table indicates the serious, well nigh, fatal condition of our forests from the standpoint of adequate supplies for the near future.

Assuming that the future rotation will be approximately 120 years (as an average for all forest regions), then our existing forests arrange themselves about as follows:

TABLE 2.—*Age Class Conditions of Forests of United States on a Rotation of 120 Years.*

	Bare land	1-20	20-40	40-60	60-80	80-100	100-120	Over 120
As it is at present.....	80	89	89	49	29	29	29	76
As it should be..........	4	78	78	78	78	78	78	..
Present conditions wrong by..	+76	+11	+11	—29	—49	—49	—27	..

This again brings out the following points:

1. The large proportion of waste land.
2. The large surplus of areas of young stuff.
3. The deficit in material 40-100 years old which is only in part made up of stuff over 120 years in age.

Evidently, now, if present methods of cutting continue at the present rate, in 50 years or so there will be left in the United States only a

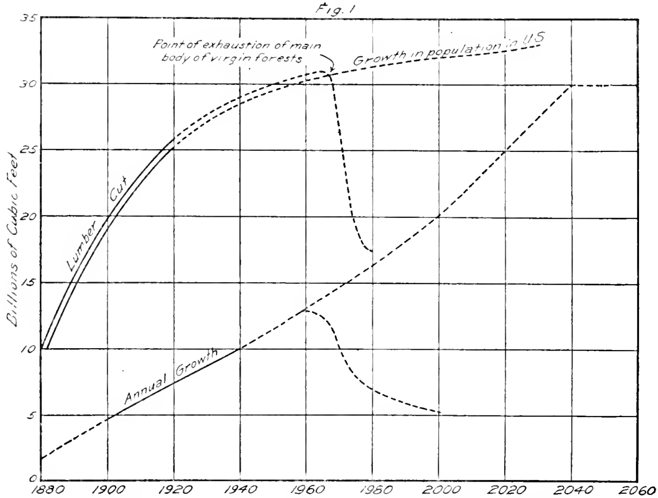
relatively small amount of timber to be cut for lumber and a vast amount of tree growth on hand, of inferior quality and of small size, suitable for pulp, perhaps, but not for construction purposes.

At the present time, in the United States, forest fires burn over an average of about 8,000,000 acres a year. It may be said confidently that, excepting the wet swamp lands, not 5 per cent of the slash lands of the United States are unburned.

These figures indicate that little can be expected in the way of relief from a timber shortage from growth from cutover lands. This may be brought out by a graph (fig. 1) indicating growth, of forest and of population, and cut of timber in the United States.

The upper curve—lumber cut—is taken from the best data available. The solid line indicates the actual amount of timber cut in the United States since 1880. It has increased steadily with the growth of population, and may be expected to continue to do so until the main bodies of virgin supplies are exhausted which will come about in 1970. From that time supplies must come from second growth.

Fig. 1



The amount of second growth material growing each year is indicated by bottom curve "annual growth." If proper forestry measures are

immediately introduced, the annual growth curve may be expected to rise until about the year of 2040 when the total area of forest land in the country is producing regular crops of wood under forest management. The total amount which can be produced is about 30 billion cubic feet per year.[1]

If restraints are not placed upon cutting at time of exhaustion of main body of virgin supplies (1970), a large amount of cutting will be done in the second growth with the result that the annual growth may be wiped out. In such a case the forest resources of the nation would rapidly go to pot.

In any case the farther forest devastation proceeds the harder it is to stop, and the more difficult it is to start forestry. People become poorer and lose heart, and need for the timber urges the cut.

Even now scarcity urges heavy cutting in second growth in the East, aggravating the present lack of growth. At the same time it is probable that 8 millions of cubic feet of timber rot in the forests of the West because the cut there is not regulated.

Evidently the very best solution is to regulate the cutting on the remaining forests in such a way that neither the volume nor the area of them is reduced, that is, in such a way that the cut takes only the growth, and a continuous supply of timber is given to the nation.

IT IS NOT ENOUGH TO PRACTICE GOOD SILVICULTURE

Good silvicultural practice alone will not insure a continuous supply of timber from the forests. It has been assumed that the most efficient method of reproducing the forests of the Pacific Coast is through clean cutting and burning; and this bit of silviculture may be employed over this entire region in the next 25 years, and very probably will be unless checked. If so, the region will be supporting great areas of reproduction (granted good fire protection) but will produce no timber for the market. Under such conditions so far as the need of the markets for timber is concerned 50 years hence the wonderful timber producing region of the Pacific Coast might as well not exist.

The aim of silviculture is to produce the most growth of the best species on the land in question: "It is the art of tending and producing a forest; the application of the knowledge of silvics in the treatment of a forest." It deals with the growth of forests and the needs of trees

[1] Watson, Russell. "National Needs and Sustained Annual Yield of the Nation." JOURNAL OF FORESTRY, April, 1921.

and is not concerned with the growth of population of the United States nor with national needs for timber. Its ideals are of the forest, not of people and industries. When the needs of the State conflict with the desires of the silviculturist, then the silviculturist must give way. Silviculture must be subservient to the needs of the State; not the State to silviculture.

We have come to such a place in the misuse of our forests that much as we may wish it otherwise, our first need is timber continuously and whether that timber is for example excellent Douglas fir or the poorer hemlock is of consequence to be sure but not of fundamental consideration. If the forest must be destroyed to get Douglas fir reproduction, as is advocated by some of the foresters who have made investigations in the region, although hemlock, true firs, and cedar can be obtained through a system of selection cuttings, by which a growing forest is left, then without question the latter must prevail.

ADEQUATE FIRE PROTECTION NOT SUFFICIENT

Nor can fire protection alone insure for us timber for the period between exhaustion of our virgin supplies and the incoming new growth. To spend all of our forestry energies on fire protection is akin in plan to laying water pipes to protect a house already burned and leaving unattended the house alongside of it that is burning. In this case all attention is being given to land which cannot supply much timber for many years, while allowing forests which *can* continuously produce, go by the board. It is a case of spending much money for rebuilding forests, but attempting in no way to prevent the destruction of those forests already built which are being torn down.

Adequate fire protection certainly is of prime importance in the country if we are ever to have forests; without fire protection there will be few forests. But yet, if the very best fire protection were now established on all forests, the young growth which would result would not be of right size nor quality to be cut in place of the virgin supplies exhausted. This is evident from Professor Roth's table of age classes.

GOOD FIRE PROTECTION WILL BE OBTAINED ONLY WITH A CONTINUOUS FOREST BUSINESS

In the white pine region of the Lake States, in the southern yellow pine region, in the western yellow pine region, in the western white pine region, sugar pine of California, and in Douglas fir of the North-

west, no adequate fire protection has yet been established. In some parts of New England and the Southern Appalachians, Southeastern Alaska, and the swamps of the South, fires have not done serious damage, because of climatic or topographic checking factors.

In the areas first named the cost of fire protection which really protects is not known. Approximately a million dollars has been spent on one National Forest in Idaho in the past decade in fire prevention and suppression, and yet two-thirds of the area of the Forest is devoid of live timber as a result of the fires in 1910 and 1919.

On the west side of the Bitterroot Mountains of Montana and Idaho, in one of the most remarkable timber regions of the country, nearly 3½ million acres have been burned on five National Forests since 1908.

The biennial report of the State Geologist of North Carolina reports that in the 10-year period, 1910-1919, approximately 395,000 acres were burned over yearly, or nearly 4,000,000 acres in the 10 years. The forest area of the State is given as 20,000,000 acres.

In Louisiana in 1917, according to the State reports, 5,568,940 acres out of 28,000,000 were burned.

In Texas in 1919, 1,207,824 acres were burned out of a total forested area of approximately 13,000,000 acres.

In Washington, the report of the State Fire Warden indicates that in 1920 the total burned over of "brush, cut-over, and old-burn" land, outside the National Forests, in the Douglas fir region of the western side of the State, was 52,221 acres. In 1919 the area of such land burned was undoubtedly yearly 200,000 acres. According to Kirkland (University of Washington, Forest Club Annual, 1921), the total area of unimproved cut-over lands west of the Cascade Mountains in Washington is about 3,000,000 acres. At the present rate of burning, that entire area, or its equivalent in area, will be burned over in about 24 years.

The forester for one of the largest timber owning companies in the sugar pine-yellow pine region of California reports that 95 per cent of all their slash land has been burned.

In Michigan, in 1919 (a bad fire year), the Biennial Report of the State Game, Fish, and Forest Fire Commissioner, of the Public Domain Commission, states that 418,419 acres were burned. Other reports, however, give it as nearer a million acres. The forest area "protected" by the State is approximately 20,000,000 acres.

The average fire loss in Minnesota for the past 12 years, is about 200,000 acres per year. These figures are from State reports and are admittedly low. The forest area protected is approximately 15,000,000 acres (it can be stretched to 25,000,000 acres by including woodlands and woodlots).

The State Forester of Wisconsin reports that he has no idea how much land is burned over each year in his State.

The fact is that the Lake States, however we may figure fire losses, have no coniferous timber coming in on the cut-over lands in quantity.

Perhaps the most serious attempt at adequate fire protection in the Lake States has been made by State Forester Schaaf, on the Michigan State Forests. The fire losses on several of the forests have been kept down to a very small per cent (less than one-half of 1 per cent of area per year) in the past 5 years, but on these forests compartment line roads ("fire lines") are built 440 yards apart in cardinal directions (that is, around every "forty") and maintained free of grass and weeds by harrowing and dragging. On other forests not so intensively equipped the average fire loss for the past 4 years has been about 3 per cent per year.

It is evident from the above that up to the present time, in the great coniferous regions of the country, attempts at State-wide fire protection have proven futile of real accomplishment. They have hardly been worth while. The number of fires has increased faster in the past few years than has the organization of the States to subdue them.

It is very unlikely that adequate fire protection will be obtained in these regions on the present cut-over lands until intensive methods of forestry are inaugurated such as State Forester Schaaf has done on several of the State forests of Michigan.

Approximately one man is needed for each 2,500 acres. That is, for each 25,000 acres a crew of eight men is needed constantly on hand for fire suppression, besides two men for lookout or patrol work. The eight men can be engaged in road building, planting, or any other work when not actually engaged in fire fighting; but they must be at hand to insure man-power in case of fire. This number is based upon the experience on the Michigan State forests, and can be relied upon as being conservative.

Such men will be employed for approximately 5 months, at an average cost of about $90 per month, or $450 a year. That is, labor alone for fire protection will cost in the Lake States fully 18 cents per

acre per year (although to be sure, this cost when a forest business is established can be largely pro-rated against other lines of work).

This gives some idea of the number of men needed for worth-while fire protection.

It is believed by men of the Forest Service who have given much thought to the problem that adequate fire protection in most pine forests can be obtained by increasing the number of men on the National Forests about three-fold. Without doubt, a large number of men are needed ready for fire fighting at a moment's call.

The question comes, now, how can these men be employed when not actually engaged in fire fighting? On those areas where a large amount of planting and of road construction is needed work will be at hand for several years, but such work will not last indefinitely. The construction of roads is usually done by large crews—done more efficiently and completed quicker.

One of the prime reasons why many men in the Forest Service are advocating that the Forest Service should do its own logging is because of the need of men during the fire season. They need men upon whom they can depend (the Forest Service has had bitter experience and much grief from irresponsible fire fighters); they want men who they can train for fire fighting, and who once trained will be available for fire work for several years; they need men of proven physical ability; and they want men who can handle crews of fire-fighters. In short, they want a crew of men trained to the work and ever on the job. Considerable training is needed to make first-class fire-fighters. Through winter logging men for fire-fighting could be given steady employment.

Fighting forest fires requires as much ability as fighting fires in cities. The city soon learned that the pick-up crew, the volunteer fire department, was a poor bet in case of a real fire, and firemen who made fire-fighting a life job were installed. The city is wealthy enough, and believes that the stake is high enough, to employ men for no other purpose than as firemen. The forester feels that other work must be found for the men at those times when they are not actually fire fighting.

This is one of the strongest arguments in support of the statement that adequate fire protection will not be obtained on the forest lands now being logged until sustained annual yield of the area (usually not over 90,000 acres in extent) is obtained. Under a sustained annual yield policy a continuous lumbering operation is carried on. On a 90,000-acre tract, cut over on a 20-year return plan, selection system,

a lumbering crew could be kept constantly at work—logging, road building and maintenance, silvical work, planting, and fire protection. A crew of forty men could be employed here constantly; and forty men to 90,000 acres would give a pretty good secondary line of defense in fire-fighting. It would just about insure adequate fire protection.

The small mobile crew of eight to ten men, experienced in fire-fighting, for each 20,000 to 30,000 acres, is without question the best fire-fighting weapon known. Without them, there can be no worth-while fire protection.

Next to men, good fire protection is obtained only when the woods are well threaded with roads. "Git thar fustest with the mostest men" is a guerilla warfare adage; and it is of true application in fire-fighting. To arrive quickly to the scene of the fire after it has been reported necessitates roads. Woods traveling, over hill and dale, jamming through the brush, is usually slow, tedious, and decidedly unsatisfactory.

That forest area which is lumbered continuously is kept in roads which are needed in the lumbering operation. It is nothing less than a bit of the greatest inefficiency to build expensive roads for lumbering, and then to allow them to fall into disrepair, when they are needed so seriously in all the forestry work which should follow lumbering. Yet they most certainly will not be kept in repair unless a use for them in the near future is assured; and it only is assured when a forest business is established.

These things every forester of experience realizes.

The great danger from fire in large areas of reproduction might be mentioned. It is one of the principal adverse criticisms made by the German forester, Doctor Martin, in 1900, in his investigations of the French system of forestry. Such areas are certain to result from forest devastation.

There is perhaps no greater fire hazard than a great clear-cut area, whether or not the brush and slash have been burned during the operations. The lumbermen of Michigan, who replied to a forest questionnaire, all laid stress upon the extreme difficulty of adequate fire protection of logging slash. Particularly is this true in mountainous regions where lightning fires are common. It is a strong argument in favor of selection cutting on a sustained yield plan. The dark forest does not burn easily.

The point of discussion is this: It is very unlikely that any organization, State, Government or private, will spend the money needed to

adequately protect an area from fire when fire protection is the sole aim of the expenditure. Especially is this true if the area is covered only with popple or oak bush. Fire protection will only be obtained when the forest property is maintained as a forest business and where the employees are fire-fighters when need be but mostly are employed for other purposes. The $5,000,000 (approximately) spent in the United States at the present time for salaries for firemen who are busy on fire, probably not over 10 per cent of the time, could under established forest business be spent for salaries for employees of forest business doing constructive forestry work.

GOOD SILVICULTURAL PRACTICE IS POSSIBLE ONLY WITH SUSTAINED ANNUAL YIELD

In order that good silviculture may be practiced on an area, the forest must be given constant attention. Forestry is the business of raising crops of timber trees. As crops they must be cared for. Thinnings must be made as the occasion demands, proper attention given to insect and fungi attacks, damage by wind, etc., which are certain to arise during the course of the years. The practice of silviculture like the practice of agriculture, even though in a rude and low state, supposes a settlement. Care of a forest not only requires men on the ground to watch constantly but also demands facilities for removing and utilizing the products of the forest.

Under the present system of forest devastation over large areas, men and equipment are removed and roads and means of transportation abandoned. It is nearly as impossible to give proper silvicultural attention to a forest without a crew of men constantly on the ground as it is to protect it from fire without men, and much the same reasons hold good in both cases.

There are many serious results of large clear cuttings which become evident by trial. Many insects appear in destructive numbers. The damage from weeds, frost, and heat is greater the larger the openings. For tender species which grow slowly in the juvenile stage it is an acknowledged principle of silviculture to avoid large openings. In fact, on the Michigan State forests, where the task of silviculture is mostly one of reforestation on the cut-over and many-times burned-over lands, it is found to be almost a hopeless task to get any coniferous trees except jack pine to grow on the barren lands. The best success by far is obtained by underplanting, that is, planting the seedlings under the

over-topping growth of sprout oaks, poplar, and maple. Such plantings, however, require attention regularly in the shape of releasing cuttings and reinforcement plantings. What is true here will most certainly be true in large measure on all forestry operations in the coniferous regions.

RATIONAL TAXATION OF PRIVATE TIMBER LANDS AND SUSTAINED ANNUAL YIELD ARE INSEPARABLE

In discussing relations of taxes to forests, three types of forest businesses may be recognized:

1. The going forest business, in which growth equals the quantity of the product, and the value of the product is approximately equal year after year. This is a common enough condition on a number of large woodlots. The tax is based primarily upon the quality of the soil to produce revenue in the shape of timber cut. The proposition is essentially similar to a farm, and can be taxed as a farm is taxed without hardship to the forest business. The scheme of taxation of farms has been evolved after a great many years of trial and apparently is the best scheme in sight.

2. The second style of forest is one which is composed of either much bare land which must be replanted if crops are to be produced, or of much young stuff, or at best is lop-sided of ages—heavy with immature trees and light with mature trees of poor quality. In this case the owner must wait many years before obtaining a revenue from his property commensurate with the productive value of the soil. The stand may be potentially large in value but at present of little commercial worth. The trees have to grow. The land may not be well stocked with trees, probably is not in fact, and planting or other means of reproduction employed, or thinnings made, to obtain good stocking.

This is the condition on a matter of 300 million acres of land in the United States (Capper Report).

A fair tax for such land is not easily determined, and above all the tax must be suited to the individual conditions of the forest property. The State of Michigan pays a flat tax of 5 cents per acre for cut-over lands within the State forests to the county in which the forests are located.

Such lands, although at present practically worthless, are yet a burden and a menace to the surrounding territory. They cannot well be isolated and left to the whims of nature. Routes of travel must be estab-

lished across them; fire may sweep from them onto adjacent communities (as in Minnesota) and so they need protection. They need also some police supervision. Whether or not, therefore, they produce anything of value, still they are an expense to the State and county. Taxes to meet this expense must be levied upon surrounding regions, for as a rule the amount of taxes obtainable from the lands themselves (5 to 8 cents an acre) is not sufficient to care for them. (Many counties on cut-over pine lands in Michigan are bankrupt. They take more money from the State treasury to pay for county improvements, schools, etc., than they get from the lands in the counties for taxes, that is, the State pays more than it gets.)

It would appear that if the owner of such a property gives to it good fire protection and builds roads, etc., such as would be done if a forest business were established, that he is bearing his expense of the land whether or not he pays taxes to the county. For he has actually saved the surrounding communities tax burdens imposed to care for the land.

When such a forest comes into sustained annual yield, then it can be taxed in the same manner as farm land is taxed.

3. The third form of forests is that one which is composed of stands of timber ready for market. The yield and the money return are at hand if desired. Owners of such a forest complain because they are taxed on a property that is yielding no returns, and which probably is not increasing much in value; the people of the county complain that the owners are holding a vast store of merchantable stuff which cost little in comparison to its value and on which no work is done. A compromise between the two is not easily effected under present methods of handling forests.

When the owner does log, under present methods, the land, because of the devastated condition following logging, becomes of low value and taxes received are small, and will continue small for a great many years whether or not the area is cared for until the forest again becomes merchantable. The system gives periods of feast in taxes and then of dearth; and the period of dearth is many years in length.

Obviously such a system is not good; and it would appear the part of wisdom for the State to insist that the forest owner practice forestry on a sustained annual yield basis in order that the taxes, based upon the quality of the land to produce timber, may be returned regularly.

RESUMÉ OF NEED OF REGULATION

It has been shown in the previous pages that neither satisfactory fire protection, silviculture, nor a system of taxation of private lands can well be established until the forest properties of the United States, private as well as Federal or State, are brought under a form of continuous forest production. It is believed that some form of forest regulation is needed. Indeed it is felt that this regulation is needed so strongly, that it may well be enforced by the Federal Government in a mandatory fashion.

It is well known that the cut of timber of the Nation is several times greater than the growth of timber in the forests. Evidently then, if sustained annual yield were put into effect immediately, the cut which would result necessarily would be lower than the cut of the present time. Unless, therefore, timber were obtained from foreign sources the adoption of sustained annual yield would force the people to use less timber than is used at present.

How much would be the cut per year under sustained annual yield?

Figured in its simplest way, and assuming that adequate fire protection is available, we get this:

Stand of virgin timber, where growth equals decay = 1,500 billion feet, b. m.	1,500,000,000,000
Cut ⅓ in 20 years, or 1/60 in one year = 25 billion feet, b. m.	25,000,000,000
Growth of second growth timber per year	14,000,000,000
Total possible cut per year during first period	39,000,000,000

(This 39 billion feet must cover not only the cut, but also timber destroyed by fire, etc.)

The growth of second-growth timber per year, now estimated at 14 billion feet, board measure, should, under adequate fire protection, be considerably more, toward the end of the period, probably more nearly 20 billion, giving the possible yearly cut as (1920-1950), 45,000,000,000.

The total amount of saw timber "consumed or destroyed" now is about 56,000,000,000 feet, board measure, per year.

How this figure of 56 billion "consumed or destroyed" stands exactly to the amount cut in the United States per year, it is impossible to determine from the Capper Report. It is certain however, that this 45 billion feet of possible cut, if translated into cubic feet, will not be more than about 15 billion. This is about three-fifths of the amount used in the United States.

It is certain that under a "cut equals growth" regulation, during the first period, the cut in the United States would be from one-third to two-fifths less than the amount used.

It is believed, however, that if adequate fire protection is given, the cut can be increased considerably during the next years, until normal production is reached or reasonably approached in say one hundred years. For this reason:

The forests of the United States *are now understocked.* The virgin forests cover 135 million acres and support 1,500 billion feet, board measure. This is about 11,000 feet per acre, for the growing stock (G_a) of average acre. The culled and second growth forests are not nearly as well stocked as this, *but they are not considered in this figuring.* The yield (y_r) of the average forest certainly should be over 30,000 feet; and the growing stock then, of the average acre, should be 15,000 feet. Fifteen thousand is 4,000 more than the present actual growing stock, indicating that the forest is nearly 25 per cent understocked. Up to good stocking with the increase in volume of growing stock, the growth increases; and with the increase in growth comes an increase in possible cut. Under sustained annual yield and adequate protection the volume of the growing stock will be built up. If the virgin forests were well stocked, their volume should be 2,025 billion feet instead of 1,500 billion feet.

We will certainly come to this reduced cut in a few years, but to thrust this upon the Nation of a sudden is not advisable.

It is here that Professor Roth's plan is of large value. It is a plan which would be used for a short period of years at best. It does not necessitate immediate reduction of cut, but does lead eventually to sustained annual yield, to a regulation by area with volume check. Under his plan forest properties would tend to bunch up, large Government, State, and private holdings would result, making conditions suitable for establishment of forest businesses.

This plan is an enforced first step in the direction of such an establishment. It has been shown in this article that such a condition is eminently needed. Until this condition obtains, however, under Professor Roth's plan the forest would not be diminished in acreage and forest devastation would be checked.

Two features of the plan, thus, should not be overlooked:

1. It is temporary, leading to complete regulation.

2. It is mandatory of application only on those properties where better or more feasible methods of cutting are not established.

The plan suggested essentially is this:

Any forest property handled under working plans approved by the Federal authorities is permitted to operate under those plans.

Regulation to a certain extent, is mandatory but the form which is used is left to the discretion of the owner except that it must be approved by the authority. Unless noted, the following regulations do not apply to properties managed under approved plans. The regulations are imposed, however, upon those forest owners who do not prepare feasible plans.

It is understood that if any forest owner does not wish to carry on a forest business, and if no private enterprise or State wishes to purchase the property, that the Government will buy it.

Farmers' woodlots are exempt, at least tacitly; but no others, State, National, or private forests.

These features of the plan should not be lost from sight.

All forests not under regular plan are cut over on the selection system with a period of return of 20 years. One-third and no more of the basal area of the stand on any 40-acre tract may be cut at any one time. In some forests this means that since the larger and taller trees will be cut first ordinarily, that the volume actually removed will be about 40 per cent of the total volume of the stand. In even-aged stands where the trees are all very nearly the same size, removing one-third of the basal area means removing about one-third of the volume of the stand.

The basal area referred to is that of the actual live timber standing on the area at the time of cutting.

No restrictions as to what kind of trees or size shall be cut are imposed, excepting that for all purposes including building of improvements necessary in the woods work, not more than the prescribed amount shall be cut. No dead or down trees are to be figured.

The plan, it is apparent, is not so much a scheme of regulation as it is a plan for inhibiting forest destruction. It leads to sustained annual yield, and thus is much superior to national plans for prevention of forest destruction through means of silviculture alone.

Under the plan the amount of timber that a man cuts off from his property is not under all conditions materially lessened. The entire property can be logged over in one year if desired; but if it is thus logged over in one year it cannot be logged off again for 20 years.

If it is considered that the virgin timber of the United States will all be logged off in 60 years, and figuring a rotation of trees on the average as 120 years, then under this plan of 20-year return and cutting one-third the volume (basal area) each cut, the virgin forests of the country are immediately placed upon a sustained yield basis. The individual property may not be in this condition, but it will be true, considering the forests of the United States as a whole.

Furthermore, by cutting only one-third the basal area (which practically equals the volume, at least after the first cut), overstocked forests are reduced in stocking, and understocked forests are automatically built up.

Illustrations of the way that the regulation by area with volume check works out with stands of different stocking, follow:

One-third of the volume is cut every 20 years.

Assume a rotation of 120 years. This will be too long for some sections of the country, and too short for others. On the average, however, it will lessen or increase the volume obtainable but very little.

Volume of stand per acre	10,000 board feet
Growth per acre per year, average acre	200 board feet
Rotation	120 years
Period of return	20 years
First felling—	
1/3 of 10 000 (1921)	3,333 feet
Second felling—	
1/3 of (10,000 — 3.333) plus growth.	
Growth in 20 years is $20 \times 200 = 4{,}000$	
— 1/3 (6,667 plus 4,000)	
— 1/3 of 10,667—(1941)	3,556 feet
Third felling	
— 1/3 of (10,667 — 3,556 plus growth)	
— 1/3 (7,111 plus 4,000)	
— 1/3 (11,111)—(1961)	3,704 feet
Fourth felling—	
— 1/3 (11,307)—(1981)	3,704 feet
Fifth felling—	
— 1/3 (11,538)—(2001)	3,846 feet

And so on, the amount of the fellings gradually approaching the amount of the growth, as the growing stock is built up to approach normal.

Take the example of a heavy overstocking:

Volume per acre (average of forest)	40,000 board feet
Growth per acre per year (average acre)	250 board feet
Rotation	120 years
Period of return	20 years

First felling (1921)—
 ⅓ of 40,000 .... 13,333 feet
Second felling (1941)—
 ⅓ 26,667 plus growth
 ⅓ (26,667 plus 5,000) (31,667) .... 10,556 feet
Third felling (1961)—
 ⅓ 24,145 plus 5,000 .... 9,815 feet
Fourth felling (1981)
 ⅓ 22,983 plus 5,000 .... 9,328 feet

Here the volume cut is gradually decreased to correspond with the amount of the annual growth; and by doing so the amount of growing stock is gradually reduced to normal.

In this case (overstocking), the G_a for the land is 15,000 feet. $(G_a = \frac{Yr}{2})$ / or G_a replaces in $\frac{R}{2}$ years. The stand was, thus, overstocked by 10,000 feet.

In the first case (understocking) the G_a is 12,000 feet. Here the stand was understocked by 2,000 feet.

Of course, any rotation may be assumed and used; and by use of different rotations different relative degrees of stocking may be obtained. The amount of growth, however, is set by the forest and the quality of site; and since by this method the amount cut depends upon the amount that grows, no serious overcutting or undercutting can take place.

The amount one-third is, to be sure, a figure that is not entirely adapted to all regions. In fact the flat rate of one-third the basal area may be modified by special permission in some cases where the quality of the site and the characteristics of the species grown produce extraordinary conditions of growth. Such may be, as examples, the alpine forests, or the very rapidly growing stands on the overflow lands of the lower Mississippi River bottoms.

In any case, there is offered by the plan, the opportunity of handling the forest on a proper working plan with entire freedom of method of cutting. It is simple of understanding and of application; it is easily checked in the field; and it maintains a forest of growing timber.

FORESTRY ADMINISTRATION ON INDIAN RESERVATIONS

By J. P. Kinney

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Subsequent to receiving a request from Mr. Zon that I present to the Society an outline of the forestry work being done in the Indian Service, I drew from its quiet resting place in my library, No. 3 of Volume X of the *Forestry Quarterly* and read again an article entitled "Forestry on Indian Reservations" that I prepared in July, 1912. It is astonishing how thoroughly one can forget in ten years, and I was really surprised when I found the last paragraph of that article to read as follows:

"And, now when every Indian shall have received an allotment, what is to be done with the surplus timberland? This question can be answered only by the Congress of the United States. On about a score of reservations in the western States there are large areas of timberland which will not be needed for allotment and which are not adapted to agriculture. These timberlands include high mountain slopes, as on the Flathead and Warm Springs Reservations, volcanic ash land which is not subject to irrigation and is wholly unfit for agriculture, as upon the Klamath Reservation, or natural forest soil, as on the Quinaielt. These areas should unquestionably be maintained as forest lands. The regulations approved June 29, 1911, and the general forms of contract adopted earlier in the same year, make provision for the conservative cutting of timber from all areas of this character. Although the ultimate status of these lands is yet undetermined, the writer is confident that the forest cover will be maintained whether the lands shall continue to be held as Indian tribal property or be acquired by the United States for National Forest purposes."

These words brought back to my mind the hours of serious thought that I gave in 1910 and 1911 to the question of the status of Indian timberlands, and to the problem of the administration of these lands in such manner as to fully maintain their value as national resources without impairing the private property interests of the owners and without interfering with the very important task of developing habits of industry and economic independence among the Indians. A close study of the

experiment that had been made in 1908 and 1909 of having the forestry work on Indian Reservations conducted by the Forest Service of the Department of Agriculture, convinced me that this plan was impracticable. I reached the conclusion that unless, or until, arrangements should be made by which the Federal Government should take over timberlands not needed by the Indians for agricultural or grazing purposes and pay the Indians therefor, such timberlands should be administered by the Department that had charge of all other interests of the Indians; that there could be no efficient administration with responsibility divided between two Departments. Eventually the Executive orders of March 2, 1909, by which an effort was made to place extensive areas of Indian timberland in the National Forest status, were revoked and the Indian Service resumed the full administration of Indian timber resources. It was not long after such revocation that the article from which I have quoted above was written.

We are today not much nearer the final determination of the status of Indian timberlands than we were in 1912. On one reservation only has the forested area been given a legal status as an "Indian Forest" by Act of Congress. This was done on the Red Lake Reservation by act of May 18, 1916 (39 Stat., 123, 137). On the other hand, all suggestions that the large areas of non-agricultural forest lands on various reservations be opened to unregulated exploitation have been successfully opposed except in the case of the Choctaw-Chickasaw timberlands in eastern Oklahoma. As the United States had no legal interest in these lands and the Congress was unwilling to appropriate the amount necessary to purchase them, the Indian Service was unable to prevent their sale, notwithstanding a strong conviction on the part of myself and others in the Service that the public interest would be served by the maintenance of a National Forest upon this very rough and non-agricultural area.

The general regulations for the administration of Indian Forest land, approved June 29, 1911, under authority of the act of June 25, 1910 (36 Stat., 855, 857), have been superseded by the regulations approved February 5, 1918, but in the preparation of the revision I kept constantly in mind the view that the Indian not only has property rights to protect but also has social and moral responsibilities as to the manner in which his property is used, and has the same interest in the future welfare of his county, State and Nation as has his white neighbor.

During nearly twelve years' service in the Indian Bureau, I have always found the Commissioners of Indian Affairs sympathetic with any plan for the conservation of timber resources and ready to enforce any regulation for the protection of the public interest, provided it did not unfairly limit the legitimate private interests of the Indian owners. The Department has consistently supported the Indian Service in its efforts to enforce conservative lumbering on all forest lands. On April 10, 1920, the Assistant Secretary of the Interior approved regulations to govern logging operations under all contracts for the purchase of Indian timber that I believe represent as great progress as has been made in this phase of American forestry practice.

Within the first five years after the establishment of the forestry work as a separate unit in the Indian Service, in February, 1910, very embarrassing situations under old timber contracts on the Bad River, Grand Portage, Lac Courte Oreille, Lac du Flambeau, and Menominee Reservations were cleared up, new contracts made and prices of stumpage increased. Sales of timber were also effected under the Leech Lake, Red Lake, and White Earth jurisdictions in Minnesota, and the first sales were made on the Jicarilla, Klamath, and Tulalip Reservations. The sales on the Jicarilla and the Tulalip Reservations established record prices for those localities and the small sales on the Klamath were significant as precursors of the development of an extensive industrial enterprise on that reservation.

An unfortunate combination of circumstances, the details of which may not with propriety be recited on this occasion, seriously impeded the development of an improved organization of fire protection, timber sales administration, and cruising work on Indian lands prior to July 1, 1914.

Almost at the beginning of the fiscal year 1915 preparations were begun for the cruising of the Menominee Reservation and the gathering of data for a contour map. This work was followed by systematic valuation surveys on the Eastern Cherokee, Quinaielt, Flathead, Red Lake, Spokane, and Siletz Reservations. The work was interrupted in 1918 and 1919 by the war, but was resumed in 1920, and the greater part of the Klamath Reservation has been covered during the past two years. Only the Menominee and Quinaielt Reservations have been entirely covered.

These surveys contemplate the making of a fairly accurate estimate of the timber on each forty-acre tract, the acquisition of reliable infor-

mation as to the character of soil on each forty and the gathering of data for an accurate contour map of each reservation examined. The strip system is used, two strips, each two chains wide being run through each forty, except where the stand of timber is both light and uniform and the surface practically level, where a single strip two chains wide may be run. Base lines are first run two miles apart and the stations (two for each forty) marked, and all elevations carefully recorded. The cruise strips are then run through the forties at right angles to the base lines from station to station. Box compasses with two and one-half needles are found satisfactory and distance are determined by a two-chain steel tape. Differences in elevation along cruise strips are determined by a six-inch Abney hand level graduated to read differences in per cent of slope. The topographic compassmen do not attempt to draw accurate contour lines in the field but aim to represent the surface accurately by form lines and the location of the contours is determined by the draftsmen from the Abney readings as corrected by the transit station elevations. The timber estimates thus obtained are sufficiently accurate for all sales in which the amount actually cut is the basis for payment, and the contour maps are as accurate as will ever be needed for forest administration in the localities that they cover.

Since 1915 extensive general sales of timber have been made on the Bad River, Colville, Coeur d'Alene, Flathead, Fort Apache, Jicarilla, Klamath, Mackinac, Mescalero, Nett Lake, Nez Perce, Lac Courte Oreille, Quinaielt, Red Lake, Spokane, and Tulalip, and many small sales on other reservations or on public land allotments have been made. During the five years 1916 to 1920, inclusive, nearly fifty general timber sales involving approximately three and one-half billion of stumpage have been effected and the amount of timber actually cut has been over one billion six hundred million feet. The income from timber sales on lands administered by the Indian Service has averaged more than one and one-half million dollars annually during the last ten years. It is interesting to note that the total income from timber sales on all National Forests for the fiscal year 1920 was about the same as the total value of the timber removed from lands under the jurisdiction of the Indian Service during the same fiscal year.

From this it will be seen that the forestry activities of the Indian Service are somewhat extensive. However, the facts above presented afford an incomplete picture of the work done. The administration of individual and collective allotment sales involves a large amount of

detail and consideration of the peculiar circumstances surrounding the individual. Those engaged in the direction of forestry work must consider the general purpose of the Congress and the plans of the Department and the Indian Office for the advancement of the Indian. Without yielding ground as to the essential principles of theory and practice, the Forestry Branch of the Indian Service has pursued the ideal of conciliatory cooperation with other branches of the Indian Service. By such policy little has been lost and much gained. Very substantial progress has been made and the future can be faced with confidence.

Within the past two years there has been a revival of the idea, first entertained in the Department of Agriculture nearly twenty years ago, that the forests on Indian Reservations should be administered by the Forest Service. The proposition has appeared in several bills offered in the last session of the 66th Congress and in the special session of the 67th Congress. It appears that these bills have been prepared in collaboration with the Forest Service, and House Bill No. 129, 67th Congress, 1st Session, known as the Snell Bill, has received the public endorsement of that Service. An explanation of the purposes of this bill so far as it affects Indian lands was contained in an article by Mr. E. A. Sherman in the April (1921) issue of the JOURNAL OF FORESTRY, entitled, "A Plan for the Disposal of Indian Reservation Timberlands."

Section 9 of the Snell Bill withholds from entry, appropriation or allotment (except as to mineral entry) all lands within Indian Reservations that may be classified by the Secretary of Agriculture (obviously through the instrumentality of the Forest Service) as "valuable chiefly for the production of timber or protection of watersheds." By Section 10 of this bill the National Forest Reservation Commission is "directed to recommend to the President the incorporation in National Forests of any lands classified as valuable chiefly for the production of timber or protection of watersheds and withdrawn from entry under the preceding section, which, in the judgment of said Commission are adapted for National Forest purposes. Said Commission is further authorized to determine the value of any lands so withdrawn which are the property of Indian tribes."

The effect of these two sections would be to place the determination of the price to be paid to the Indians for their legal or equitable rights in reservation timberlands almost solely in the discretion of the Forest Service in the Department of Agriculture, which is charged by the bill

with the duty of making the only examination, classification, and appraisal for which an appropriation is provided. The only direct official representative that the Indian owners of this property—worth possibly sixty millions of dollars—have in this proposed transaction is the Secretary of the Interior, who is one of the seven members of the National Forest Reservation Commission; but he is not provided with the means of ascertaining the value of the property to be taken from the Indians. Theoretically the other six members of the Commission, all responsible public officials, would approve no valuation that was not entirely fair to the Indians; but practically these officials would in all probability have even a weaker basis for a judgment than would the Secretary of the Interior. It might be difficult for representatives of the Forest Service to place themselves in the role of disinterested appraisers. It would be far more difficult to convince the Indians that a just appraisal thus made was in fact a fair one. The bill contemplates a sort of condemnation proceeding in which there is an opportunity for the suggestion that the appraisal is to be made by a party having an interest in the subject matter of the appraisal.

Unless my observations of the mental processes of the Indian and of his characteristic attitude toward communal property have been exceedingly superficial and faulty the taking over by the United States of this vast property without agreement with the Indians as to the price to be paid would arouse a storm of protest that would be followed by an interminable re-presentation of a claim of unjust treatment. And, conceding for the present that such a procedure might be sustained in the courts, at least as to many reservations, is this course in keeping with the spirit of our institutions and in the long run will the public conscience approve a course that smacks somewhat of star-chamber methods? The author of the provisions in the bill, that I am informed Mr. Snell introduced by request, regarding the valuation and expropriation of Indian timberlands did not, I believe, have the proper legal perspective as to Indian lands. These lands are private property, held in sacred trust by the United States for the benefit of the Indians. If trust property is to pass into the hands of the trustee, the circumstances of the transfer should be such as to repel any suggestion of a breach of trust.

In discussing the question of adequate compensation to the Indians for the property taken for National Forest purposes, Mr. Sherman ventured the remark that honesty of purpose in recognition of the equities

of the Indians probably was "not a rare attribute peculiar to some one Bureau alone." This subtle sarcasm was evidently directed toward the Bureau with which I have the honor of being officially connected. Superficially considered the suggestion of the competency of the Forest Service to assume the role of guardian of the interests of the Indian may seem incontrovertible. But careful consideration will, I believe, reveal the weakness of such a position. Gentlemen, there is such a thing as habit of thought. "How use doth breed a habit in a man." Foresters are trained to a certain habit of thought. I do not decry it. It is a great possession. Yet he would be a bold man who would deny that this most praiseworthy habit may impose limitations on one's capacity to perceive promptly all phases of a complex question. The Indian problem is a complex one—one of the most perplexing ones with which our National Government has to deal. There are many problems connected with the educational, social, and industrial uplift of this race yet unsolved. The administration of their property interests is inseparably intertwined with the other phases of Indian administration. That Congress should direct that millions of acres of land be taken from the reservations without consideration of the grazing and other interests of the Indians seems to some of us a debatable question. Any view that the only interest involved is a public interest is erroneous. Any assumption that the representatives of a Bureau whose function has been for years, and now is, the administration of public timberlands is as well qualified to interpret the desires and determine the needs of the Indians as the Bureau that has been in intimate touch with the Indian problem for seventy years is open to attack. Does the man that has normally thought in terms of science put on easily the cloak of the literary critic? Does he that has habitually trained his mind in the theories of one political school, easily assimilate the fundamental concepts and convictions of the opposing party? Purity of purpose is not the only test of proficiency.

I am not a veteran in the Indian Service, yet I have personally known of several instances in which officials of the Forest Service have exhibited either a non-sympathetic attitude or a lack of capacity to understand the viewpoint of the Indian. This is not remarkable. These men are trained in the care of public lands. There seems an almost ineradicable disposition on the part of representatives of the Forest Service to consider unallotted Indian lands as public lands. The highest legal authority announced many years ago that the title to Indian unallotted

lands was held by the United States, burdened only by the right of occupancy by the Indians; but subsequent legislation and executive and judicial interpretation have recognized something more than a mere right of occupancy and have considered tribal lands as Indian property held in trust by the United States. I do not believe that we shall return to the earlier viewpoint.

If the latter view be the proper one, should not the Government department standing in closest relation to the Indian decide what lands are needed by them and what lands may well be sold? If large appropriations are to be made for a classification of Indian lands, should they not be accredited to the Interior Department and the classification made with due regard to the requirements of the Indians for agricultural and grazing lands and from the viewpoint of an owner of private property who is contemplating the advisability of disposing of the part of the property that he will not actually need for domiciliary or industrial purposes? I feel that the Federal Government may very properly insist that it should have the preference right to purchase any forest lands that are to be sold by the Indians and that after Indian lands are classified, the Forest Service should determine whether certain lands that are not needed by the Indians should be acquired as National Forests. Full information as to the basis of classification and the character of the land offered would then be available for the consideration of the Forest Service.

I am of the opinion that Indian lands bearing a heavy stand of merchantable timber, even though they be non-agricultural in character, should remain under the jurisdiction of the Indian Bureau until the mature timber is marketed and that the transfer of the interest of the Indians on the basis of an appraisal, as contemplated by the Snell Bill, would almost certainly mean the receipt by the Indian owners of a much smaller return than would be obtained through a continuation of the present policy of selling the mature timber on scale. My views on the whole question have changed little since 1912, except that longer association with the Indian problem has convinced me that the completion of allotments to the Indians on a reservation often does not satisfy the economic needs of the group as to land ownership.

ON THE CAUSE OF THE DARKENING OF THE HEART-WOOD OF CRYPTOMERIA JAPONICA DON[1]

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Of all the conifers, "Sugi" (*Cryptomeria japonica Don.*) has the most extensive range in Japan, ranking second only to "Akamatsu" (*Pinus densiflora* S. et Z.). Owing to its longevity and rapidity of growth it attains a considerable size, the largest being 120 feet in height. Many specimens of "Sugi" are known among the people of some localities as gigantic trees, together with those of "Kusu" (*Cinnamonum camphora* Nees. et Eberm.), "Benihi" (*Chamaecyparis formosensis* Matsum.), "Icho" (*Ginkgo biolaba* L.), "Shii" (*Pasania cuspidata* Oerst.), "Mukunoki" (*Aphananthe aspera* Planch.), "Keyaki" (*Zerkowa serrata* Mak.), and "Katsura" (*Cercidiphyllum japonicum* S. et Z.). There are beautiful natural stands of this species in the State Forest of Nagakisawa in Akita Prefecture, and the natural growth of the same in the State Forests of Yakushima is quite famous for the production of figured and close-grained timber. Because the tree is easily propagated and the wood is so widely used it has been cultivated for a long time throughout Shikoku, Honshu, and Kyushu. Beautiful artificial forests, of which those privately owned in the Yoshino district of Nara Prefecture are the most notable, are found here and there in all districts.

Thus, because of the many uses to which it may be put and the high respect in which it is held, "Sugi" is the commonest and most important of Japanese timber trees. It has therefore been the subject of many studies in regard to raising of seedlings, replanting, diseases, growth, yield, and technical properties of the timber. We have been interested in making a somewhat detailed study of the cause of the darkening of the heartwood, a study which may have a great bearing on our forestry from the economical point of view. The present investigation may provide data which will be of value to those

[1] This paper is an abstract from the article in Japanese of the same title, with two plates, published in the Bulletin of the Forest Experiment Station, No. 16, 1917, pp. 1-78.

who are endeavoring to control the phenomenon as well as to throw some light upon the general question of the natural staining of woods.

PREVIOUS HYPOTHESES AS TO THE CAUSE OF BLACK HEARTWOOD OF "SUGI"

The heartwood of "Sugi" (*Cryptomeria japonica* Don.) is normally reddish. This ordinary heartwood of trees called "red tree" is sometimes replaced by dull red or reddish brown wood known as "black wood," "black Sugi," or "black heart." These unusual colors turn to dark brown on exposure to air, bleaching out gradually to grayish brown. It is not uncommon for all the trees of one "compartment" to produce this kind of wood almost exclusively. Mention must be made of the case where the color change above described takes place while the tree is still standing, the reason for this will be discussed later in this article.

The wood put on the market varies in tint from pink, reddish, red, dull red, to reddish brown or even grayish brown. It is usually uniformly colored, but sometimes longitudinal bands of more or less normal colored heartwood alternate with dull or deep colored streaks. Brownish or dark colored wood is usually of lower price, especially when it is used as cooperage material. Staves from this dark lumber, for instance, are sometimes valued at only one-fifth of the price of that of high quality. The phenomenon has accordingly attracted the universal attention of thoughtful foresters in all districts, actuated not only by the economic point of view but also interested in the fact that the phenomenon is peculiar to "Sugi."

Up to the present, however, the cause of the phenomenon has remained quite unknown, although three hypotheses have been put forward to explain it. (1) That it is due directly to some ferrous compounds locally abundant in the soil. (2) That it is due indirectly to the site. (3) That these "black wood" trees belong to a separate variety.

1. The direct chemical hypothesis is diametrically opposed to the truth as will be shown later. Moreover, this hypothesis is rendered impossible by the occurence side by side in the same stand of normal "red trees" and "black trees," and particularly by those cases of unilateral distribution in the same trunk. It also does not explain why the darkening is confined to the heartwood of "Sugi" while *Castanea* and *Pasania*, both of which are rich in tannin can grow side by side with "black trees" without any trace of darkening in their woods. There are very few references to this kind of wood-staining which have

come to the author's notice. We owe to Dr. v. Tubeuf and F. W. Neger the most extensive investigations in this field where fungi do not come into play. But it is clear that v. Tubeuf's conclusions [2] are not applicable at all points to this case. Very significant in relation to this discoloration process are Neger's studies of basswood, where a similar phenomenon has been observed.[3] Yet it may be pointed out that his chemical data do not satisfactorily support his conclusions. It is significant that the same author in his next work did not state positively that the red staining undergone by the wood of alder was caused by the co-existence of tannin and iron.[4] Thus the chemical hypothesis as to the cause of the production of "black tree" has no evidence in its favor and our data prove that there is no reason to believe that tannin and ferrous compounds, or either one of them separately, is responsible for the appearance of "black tree."

2. "Site" had often been suggested by careful foresters as the indirect cause of the phemonenon, as in the case of "black oak." [5] There is evidence that site is responsible, to some extent at least, for the production of "black tree," as will be shown in this article. It cannot, however, be the only cause as trees growing closely together may be partly normal trees and partly "black trees." On the other hand, there is every reason to believe that site includes a number of influences, of which some may come into play as indirect causes rather than as direct ones. The nature of such factors is, however, unknown. It is evident, therefore, that this hypothesis cannot be accepted as conclusive beyond the suggestion that site would play on the whole a subordinate rôle.

3. The third hypothesis, namely that "black trees" are a variety ot "Sugi" is a very commonly accepted view at present in some districts, "black trees" are to some extent externally different from normal individuals; which would favor this hypothesis but most of these differences are of local significance only. Furthermore, these external differences recognized as the characteristics of "black tree" are not present before the age at which the heartwood begins to exhibit the darkening characteristic of "black wood." In this connection it is interesting to consider those cases where the "black wood" occurs

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[2] v. Tubeuf, C. Tintenholz in lebenden Fichten. Naturw. Zeits. f. Forst- u Landw., Juni, 1911, pp. 273-276.

[3] Neger, F. W. Die Vergrünung des frischen Lindenholzes, id, Juni, 1910, pp. 305-313.

[4] Neger, F. W. Die Rötung des frischen Erlenholzes, id, 1911, pp. 96-105.

[5] Keen, G. R. Aeroplane Timber. London, 1919.

unilaterally or sporadically in a normal tree. This would be difficult to explain on the variety hypothesis. The external differences often attributed to the mature "black tree" (branches more pendulous than normal, rind not so shaggy as that of "red tree," etc.) might be explained as the result of abnormal internal physiological conditions, a high water content, for instance. The marked color change of "Sugi," which occurs in winter on the needles of unshaded trees, might seem to have an important bearing on the problem. The red coloring matters then produced we have found to be not anthocyanins but carotin and xanthophyll. The constancy of leaf color is sometimes given as one of the characteristics of "black tree;" this is not plausible as will be seen when the evidence given later in this article has been considered. Although this is obviously another question and one in which many factors are involved, it seems partly dependent upon the above mentioned difference in water content.

TRUE CAUSES OF THE DARKENING OF HEARTWOOD OF "SUGI"

It seemed possible that the reason for our ignorance as to the cause of the darkening of the heartwood of "Sugi" lay in the lack of any detailed experimental observations. From a number of specimens from both freshly felled and old air-seasoned wood we determined the fact that hyphæ are absent from the wood under discussion. The discoloration was therefore assumed to be of a purely chemical nature and the experiments showed:

(*a*) Darkening of the fresh wood on exposure to air was entirely removed by oxalic acid and the original color was instantly recovered. But the normal "red wood" and some other coniferous woods previously stained with catechol have been similarly faded on the application of the same acid.

(*b*) Chemical analyses of the heartwood of "sugi" showed the following results:

TABLE 1.

No.	Habitat	Tint	Weight	Fe O	Si O
			Grams	*Per cent*	*Per cent*
1	Nagakisawa (Akita)	Dark brownish	24.6662	0.006	0.021
2	Nishikawa (Niigata)	Yellowish brown	18.3290	0.001	0.010
3	Motoyama (Kochi)	Dark brown	11.4323	0.009	.....
4	Meguro (Tokyo)	Red	16.7410	0.011	.....

These results show that "black wood" is not constantly characterized by a large amount of iron. It should also be noted that in many cases a consideration of these results and the supposed existence of tannin, which might be of an insoluble form, might be deceptive in a discussion of wood staining.

(*c*) While it was impossible to extract the color from shavings of "Jindai-Sugi"[6] and from shavings of *Castanea* or *Pasania* wood colored deep blue with ferric chloride by infusing in water, shavings of "black wood," infused immediately after discoloring, were soon somewhat bleached, giving the extract a red or purplish red color. Color-extraction proceeded much more rapidly in alcohol, usually resulting in a deep red infusion. These experiments showed that the coloring matter concerned in this phenomenon is somewhat soluble, while tannin-ferrous compounds were found to be insoluble. They could not have been present in the infusions.

(*d*) Whereas the tint of "Jindai-Sugi" and that of *Castanea* and *Pasania* stained by ferric chloride were very stable, the dark brown color of "black wood" was unstable, under ordinary conditions changing to brown in a few days and then bleaching out gradually to grayish brown, reaching the final stage after a few months. The fading was not due to the incidental seasoning of the wood as was easily proved by its inability to regain its former color when it was returned to its original moist condition by wetting; there had been, therefore, a chemical change, going on step by step.

(*e*) The darkening of freshly prepared "black wood" could be prevented by soaking in water, so that the chemical substances responsible for the phenomenon, or one of them at least, were extracted by the treatment. Several sets of tests with ferric chloride, however, gave no evidence of the existence of tannin in these infusions, except the green color reaction which disappeared upon shaking and which was apparently due to the remnants of catechol abundant in the fresh sapwood of "Sugi." Owing to the existence of some particular organic

[6] "Jindai-Sugi," which is highly prized for ornamental purposes, is, in reality, nothing else than "Sugi" wood at the earliest stage of fossilization, having been accidentally buried for a long time. A large quantity of imitation wood is manufactured by several artificial methods. There is a well-accepted hypothesis that the deepening of its tint on exposure to air is due to the ferrous oxide present in the wood being oxidized to ferric chloride, which is able to combine with tannin and cause the color change. But the tint when once produced is of long duration.

substance contained exclusively in all the heartwood of "Sugi," a substance which is easily soluble in water and gives very marked red or purplish red color with alkali, qualitative tests of tannin or gallic acid were not applicable to the infusions. Potassium cyanide gave a red color to the infusions, but the color was quite steady and not like that produced by tannin which disappears and may be brought back by shaking. Tests of wood extracts at several different stages of conversion gave confirmatory results. No trace of iron was observed in these infusions, and we were unable to produce the dark color of "black wood" by darkening the wood artificially with ferric chloride and ferrous sulphate.

These experiments show that water-soluble tannin or ferrous compounds do not come into play and radically deny the chemical hypothesis.

PARTICULAR SUBSTANCE CONTAINED IN THE HEARTWOOD OF "SUGI"

It is of seeming significance that this kind of darkening of the heartwood is peculiar to "Sugi" as far as Japanese trees are concerned, and that this particular substance is limited to the heartwood of "Sugi." A few years ago the present writer conducted a series of experiments with wood shavings to test the reaction with alkali in regard to the fluorescence of wood infusions.[7] The color of the infusions from fresh "red wood" was mostly reddish and that of well dried materials faint red, while the old air-dried materials gave generally faint yellow or colorless infusions. But all these infusions turned to distinct red or purplish red with alkali and no parallel to this was then found among the infusions of other Japanese woods, although some tropical woods came later to the writer's notice as somewhat comparable.[8] On the other hand, the infusion from such grayish brown materials as completely culminated in the conversion of tint was entirely devoid of this marked color reaction.

These experiments and the fact that shavings from fresh "black wood" can be freed from the darkening after slight extraction with water, favor the view that the "particular substance" in question is at least one of the factors largely responsible for the phenomenon.

[7] Fujioka, M. On the Fluorescence of the Infusion of Woods. Bulletin of the Forest Experiment Station, No. 15. 1914, pp. 46-64 (in Japanese).

[8] Fujioka, M. Fluorescence of the Infusion of the Woods of South Sea Islands. Bulletin of the Forest Experiment Station, No. 21, 1920, pp. 89-103.

It is, therefore, essential to examine the nature of this substance with considerable care.

It is readily soluble in water, alcohol, and wood spirit, fairly soluble in acetic ether, and can be extracted with glycerin. It is also soluble in ether when wet; but insoluble in benzene, benzol, petroleum ether, carbon bisulphide, etc. The red color produced upon the addition of alkali to the aqueous extract of the heartwood is turned to yellow with acid, while it can be changed again to red or purplish red with alkali, e. g., the color reaction is more or less reversible with alkali and acid. Chemical investigations of this substance had already been carried out by pharmacologists, interested in the close relation to the wood of "Sugi" to the Japanese "Sake" industry, where the container is made of staves of this wood. But, since it is amorphous, no definite chemical formula can be given to this substance. K. Keimatsu [9] supposed it might be one of the polyhydric phenols. H. Kimura [10] states that it might be something like orthoquinone, an oxidation product of catechol (which is derived from glucovanillin, which is itself derived from coniferin). As the definite chemical composition of this substance is unknown, in this article it will be termed "particular substane," or "chromogen" of the phenomenon for the sake of convenience and simplicity. Catechol is a well-known substance existing in woods.[11] Puran Singh [12] reports the diminution of the catechin content in the wood of *Acacia catechu* during storage as well as while it is standing.

The authors' experiments with ferric chloride on the fresh sapwood of "Sugi" compared with those of pine, spruce, fir, maple, basswood, cottonwood, etc., suggested the abundant existence of catechol therein, showing a marked green tint. Methyl alcoholic extract of the sawdust of the same material gave a green color with ferric chloride, which turned to purplish red on the application of sodium bicarbonate. These

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[9] Keimatsu, Katsuzaemon. On the Ingredients of the Wood of "Sugi." Journal of the Japanese Pharmacology, No. 277, 1915 (in Japanese).

[10] Kimura, Hikoemon. On the Ingredients of the Japanese "Sake." Journal of the Japanese Pharmacology, No. 284, 1905 (in Japanese).

[11] Tunmann, O. Phlanzenmikrochemie, Berlin, 1913.

[12] Puran Singh. A Short Preliminary Note on the Suitability of the Dead Wood of *Acacia catechu* for Katha-Making. Indian Forester, vol. 38, April, 1912, pp. 154-156.

Puran Singh. Note on the Effect of Age on the Catechin Content of the Wood of *Acacia catechu*. Indian Forester, vol. 41, Dec. 1915. pp. 482-485.

color reactions all agree with those of catechol. The authors also determined by microscopical examination of "Sugi" that newly developed woody cells showed the so-called coniferin reactions while they were not able to be stained by phlorogluein and hydrochloric acid. The above observations may lend support to H. Kimura's explanation of the derivation of "particular substance" from coniferin.

The "particular substance" is found not only in true heartwood of "Sugi" but also in its false heartwood. Considerably before marked evidence of the normal heartwood of individual trees is visible, it may occur even in those reddish brown spots caused by wounds or sporadic staining as false heartwood. Slips, by which this tree is widely propagated, show the pathological formation of heartwood in the cut ends the year after their insertion. In these cases, the false heartwoods are more or less different from normal heartwoods in tint because the causes responsible for the production of the "particular substance" exactly comply with those for the conversion of tint, as is explained later.

As several sets of facts help to explain the view that the "particular substance" is merely an accessory of the principal coloring matter of the heartwood, it seems possible that the causes responsible for the production of heartwood in general must also be responsible for the production of this substance.

Although the formation of heartwood, normal and false, has been the subject of considerable discussion among many investigators [13] an exact

[13] v. Alten. Versuche und Erfahrungen mit Rothbuchenholz. Forst—u. Jagdztg., 1895.

Frank, H. Ueber die Gummibildung im Holze und deren physiologischen Bedeutung. Ber. d. deut. Bot. Ges., 1884, p. 323.

Gaunersdorfer, J. Beiträge zur Kenntniss der Eigenschaften und Entstehung des Kernholzes. Sitsungsber. d. k. Akad. d. Wiss. Wien, Bd. 75, Abt. 1, 1882, p. 28.

Hartig, R. u. R. Weber. Das Holz der Rothbuche. 1888.

Hartig, Th. Allg. Forst—u. Jagdztg., 1857. p. 283.

Herrmann, E. Ueber die Kernbildung bei der Rothbuche. Zeits. f. Forst—u. Jagdw., 1902. pp. 596-617.

Kraus, E. Ueber Ausscheidung der schutzholzbildenden Substanz an Wundflächen. Ber. d. deut. Bot. Ges., 1884.

Lindroth, Beiträge zur Kenntniss der Zersetzungserscheinungen des Birkenholzes. Naturw. Zeits. f. Forst—u. Landw., 1904. p. 393.

Münch, E. Die Blaufäule des Nadelholzes. Naturw. Zeits. f. Forst—u. Landw., 1908. p. 44.

Münch, E. Untersuchungen uber Immunität und Krankheitsempfänglichkeit der Holzpflanzen. Naturw. Zeits. f. Forst—u Landw., 1909. p. 133, p. 158.

Münch E. Ueber krankhafte Kernbildung. Naturw. Zeits. f. Forst—u. Landw., 1910. pp. 533-547, pp. 553-569.

Ohnacker. Zer Buchenschwellenfrage. Allg. Forst—u. Jagdztg., 1889. p. 124.

and thorough knowledge of this complex phenomenon, of which the mystery is almost as deep as the mystery of the life, still remains for further investigations. Yet some commonly accepted views as to the conditions necessary for its formation may be of assistance in the present investigation. These necessary conditions are the presence of moisture, the contact with air, and the death of cells, so far as we have observed. Among many young trees standing close together, those which had noticeable wounds, mostly at the base of the boles, indicated much earlier production of heartwood than other trees without wounds. This precocious conversion of sapwood into heartwood, together with the eccentric location of heartwood starting from the outward wounds, and its extraordinary irregular form apparently induced by wounds, offers a reasonable explanation of the above view which is found to be exactly applicable to the production of "particular substance." The reason for the difference in color, which is usually noticeable between false and true heartwoods, will be given later.

DARKENING OF THE HEARTWOOD AND ITS DIRECT CAUSES

The actual occurrence of this phenomenon may be classified under two heads. The color change takes place in some woods upon their exposure to the air passing through the several stages, while in others the process is more or less completed while the tree is still standing. Although the actual stages of the color change in the latter case can not be observed, they may be supposed to undergo the same process as the former.

In connection with these stages of the conversion, detailed observations made on a 1 inch board of "black wood" will be given as a typical example. This board was of course of high water content (one of the characteristics of "black wood" as compared with normal "red wood"). Its freshly planed surface was dark red turning to a

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Präel. Untersuchung von Schutz—und Kernholz der Laubbäume. Dissertation, Berlin 1888.

Schwappach. Beitrage zur Kenntniss der Qualität des Rothbuchenholzes. Zeits. f. Forst—u. Jagdw., 1894. p. 534.

Temme. Ueber Schutz—und Kernholz, seine Bildung und seine physiologische Bedeutung. Landwirtsch. Jahrb. Bd. I. 1885. p. 465.

v. Teubeuf, C. Normale und pathogene Kernbildung der Holspflanzen und die Behandlung von Wunden derselben. Zeits. f. Forst—u. Jagdw., 1889. pp. 385-398.

Tuzson. Anatomische und mikrochemische Untersuchung über der Zersetzung und Konservierung des Rothbuchenholzes. Berlin 1905.

Will A. Beiträge zur Kenntniss der Kern—und Wundholzes. Dissertation, Berlin 1899.

somewhat grayish red after a short time and then progressively to deep grayish brown as the outer part got slightly dried, e. g., after about two or three hours. The deepening of the tint gradually advanced until it culminated in about eight hours, giving a dark brown color which was kept for about two days. The color began then to bleach out and changed to dull brown three weeks later. This tint lasted comparatively long, say, during two or three months. After that time it faded slowly to a final light grayish brown when the board was almost airdried five months later. Even this final tint is subject to the general very slow change of wood color on exposure to air and light.

Notwithstanding the time necessary for arriving at each stage of the conversion or completing the whole process, together with the density of the colors, differing naturally with the cases, the deepening was confined to the outer parts of the wood. On thinner test pieces prepared from the same material and subjected to rapid seasoning, putting in air or water-bath, the change of tint was limited to the superficial parts and not so deepened as the control left in the room under natural conditions. As the shavings from the inner parts of these test pieces were yet able to follow a deepening process in the same intensity, when they were kept again under moist conditions, the existence of ample moisture is clearly one of the conditions necessary to the deepening; but light had no influence upon it. While hydrogen and oxygen accelerated the process, test pieces kept on exposure to carbon dioxide were not only unstained but also rather bleached out. But, on the other hand, the control tests with normal "red wood" kept in the moist condition showed the same kind of the deepening to some extent. Even timbers of "red tree" left in shady woods show the darkening at least at the ends. Lumber from the same source becomes dull colored when it is piled for a long time under moist conditions, as is sometimes the case in sawmills. Furthermore we are confronted by the more familiar examples that the "red wood" used in the parts of our buildings exposed to moisture show a somewhat similar darkening. Thus, at first sight, it appears that moisture is the primary rather than the secondary cause of this phenomenon. Yet, the darkening attained by "red wood" in these cases occurs far more slowly and is not so dark in comparison with that of "black wood" in corresponding cases. So the moisture content, by which "black wood" deviates from "red wood," can not be considered as the direct cause, although it and air are the conditions necessary for darkening.

We have next to take one more consideration into account. Mr. K. Toyohira[14] suggested, in connection with his investigation of the identification of "black tree," that an oxidizing enzym might be responsible for the phenomenon. Weevers[15] found that the blackening of the non-living parts of the plant is induced by the same enzym oxidizing catechol. We examined the wood and found that the distribution of oxidizing enzym is confined to the fresh sapwood of both red and black woods. So an oxidizing enzym does not come into play in this case.

In endeavoring to obtain a more reliable basis for the elucidation of this phenomenon, we may well pay attention to construction work using cement, concrete, mortar, etc. In these cases when strong alkali comes into contact with the heartwood of "Sugi," a very advanced stage of the conversion can be seen at once. Experiments with very dilute alkali induced fresh "red wood" to give the appearance of natural "black wood." The fumes of ammonia were used to advantage in this case, changing the tint immediately; first to dark brown and then to grayish brown, i. e., all stages which occur naturally in "black wood" were exhibited within a short space of time. Parallel tests with other kinds of wood have never given an equal darkening. The above experiments favor the view that the "particular substance" under question is one of the direct causes of this phenomenon, since the sole part affected is the heartwood of "Sugi" and since this "particular substance," giving a distinct reaction with alkali, is limited, in its distribution among Japanese woods, to this same heartwood.

Many tests and observations based on quite a number of pieces of the wood of "Sugi" suggested the existence of a correlation between the tint of the wood and the quantity of this substance, as well as some chemical change of this substance at the time of conversion. A set of colorimetric tests upon the aqueous extracts of many shavings were therefore carried out to test the former assumption, utilizing the marked color reaction with alkali. This showed that "particular substance" is generally more abundant in the wood of denser tint, agreeing with the well-known fact that "black wood" is usually more or less dense colored. In regard to the second assumption, we made the following four sets of colorimetric tests in the same way.

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[14] Toyohira, Kinsuke. Identification of Red and Black trees of "Sugi" in Kagoshima-Province. Report of Alumni Association of Kagoshima High School of Agriculture and Forestry, No. 1, 1913. (In Japanese.)

[15] Czapek, F. Biochemie der Pflanzen, Bd. II, Jena, 1905, p. 642.

(I) Shavings were first subjected to rapid drying which enabled those of "black wood" to avoid the extreme darkening. 0.2 gram of each material were then extracted with 10 c. c. water during one hour. 5 c. c. of each infusion was taken into separate tubes with one drop of 9 per cent alkali. To get equal tint in each infusion, excess water was added to the denser, using the lightest one as the standard of comparison.

TABLE 2.

No.	Habitat	Kinds of wood	Tint of infusion	Diluted water (c. c.)
1	Tomioka (Shizuoka)	Black	Faint red	15.5
2	Ikawa (Shizuoka)	Black	Faint yellow	11.0
3	Awa (Chiba)	Black	Colorless	10.0
4	Tamagawa (Shizuoka)	Black	Colorless	21.8
5	Togakushi (Nagano)	Red	Colorless	6.5
6	Yokota (Iwate)	Red	Colorless	6.0
7	Kohya (Wakayama)	Red	Faint red	3.0
8	Okutani (Hyogo)	Red	Faint red	0.0

The above results show that "particular substance" is more abundant in "black wood" than in "red wood."

(II) The same tests were made with rapidly dried shavings from green "black wood" (No. 1-6, Table 3) and the shavings from the inner part of both air-dried red and black woods (No. 7-9 and No. 10-11, respectively), and gave the following results:

TABLE 3.

No.	Habitat	Kinds of wood	Tint of shaving	Diluted water (c. c.)
1	Tamagawa (Shizuoka)	Black	Reddish	11.5
2	Tamagawa (Shizuoka)	Black	Reddish	12.0
3	Motoyama (Kohchi)	Black	Dark reddish	13.0
4	Hinokinai (Akita)	Black	Dark red brown	2.5
5	Hinokinai (Akita)	Black	Dark yellowish red brown	19.5
6	Nifuna (Akita)	Black	Dark grayish red brown	31.5
7	Nibetsu (Akita)	Weak black	Dark yellowish red brown	16.3
8	Nishikawa (Niigata)	Weak black	Dark yellowish red brown	0.0
9	Nishikawa (Niigata)	Weak black	Yellowish	25.0
10	Utosawa (Shizuoka)	Red	Reddish	31.0
11	Okutani (Hyogo)	Red	Reddish	0.0

These results also prove the fact that "black wood" surpasses "red wood" in the content of "particular substance," with the one exception of No. 10, to which particular attention is to be paid, according to the reason supplied later.

(III) To verify the fact that "particular substance" undergoes a chemical change in this phenomenon, a thin board was prepared from green "black wood" and exposed to ordinary conditions. Immediately after the complete darkening of the surface, shavings were taken from both outer and inner parts of the board and their infusions were tested after the following duration of extraction.

TABLE 4.

Portion of board	Duration of extraction		
	20 minutes Diluted water (c. c.)	30 minutes Diluted water (c. c.)	60 minutes Diluted water (c. c.)
Surface	0.0	0.0	0.0
Interior	12.0	18.0	28.0

This shows clearly the diminution of the content of "particular substance" in the outer part affected by the darkening.

(IV) For the same purpose as (II), each of the 16 shavings prepared from green "black wood" was cut into two pieces; half piece of each was subjected to rapid drying to avoid the extreme darkening, keeping it moist. Small pieces of equal quantity were provided from the contiguous parts of the original shavings as test materials. These small pieces made six groups and three sets of colorimetric tests as shown in the following table:

TABLE 5.

Kinds of shavings	Number of Set		
	I Diluted water (c. c.)	II Diluted water (c. c.)	III Diluted water (c. c.)
Slightly stained.......	25.0	39.0	16.6
Dark brown...........	0.0	0.0	1.3

This shows the chemical change undergone by the "particular substance."

The above statements and data, and the fact that the darkening is easily removed with acid while the color reaction of the infusion, on the other hand, is somewhat reversible with alkali and acid, are quite enough to conclude that "particular substance" is at least one of the direct factors causing this phenomenon. Here for convenience we call the same substance the "chromogen of the darkening."

It is now evident that the darkening is associated with chromogen peculiar to "Sugi." Yet, the same chromogen is common to all kinds of the heartwood of "Sugi" and therefore it can not be the sole factor, as pieces of wood from one and the same tree or pieces equal in their chromogen content are sometimes darkened and sometimes not darkened. At least there are remarkable differences in the appearance of woods having equal amounts of chromogen. It is accordingly necessary to take some other factor into account to secure a more satisfactory explanation of this phenomenon.

The darkening undergone by "red wood" when used under natural wet conditions, or artificially produced by alkali, always corresponds to some stage in the color conversion of "black wood." The dark brown color in particular, identical with that of "black wood" in the first stage of darkening, is obtained when green "red wood" is treated with very dilute alkali. This color can be removed with acid as in the case of "black wood." In both cases the tint is not only similar but also subject to the same process of fading afterwards, through the same stages of conversion, and culminates in grayish brown. While the aqueous or the alcoholic extract of the wood or shavings, made immediately after the darkening, is equally reddish like the basic infusion of the woods, the extract of the wood in the advanced stage of conversion is simply yellowish as that of the basic infusion of the wood after long exposure to air or that of the same changed on the application of acid.

These facts lead to the consideration that the other factor may be an hydroxyl group. The question may here arise as to the difference in the color of the infusion and that of wood when treated with alkali. The following facts seem to give an explanation:

(I) The infusion immediately after the darkening of the wood is red or purplish red.

(II) On the application of concentrated alcoholic extract of heartwood, sapwood of "Sugi" and other coniferous woods shows a somewhat similar color to that of "black wood." Parallel tests with catechol solution (prepared by treating catechol first with ferric chloride and then with alkali) gave similar results.

(III) The drops of dilute alkali put upon the heartwood become red in color while the parts of the wood in contact with the drops change to dark brown.

(IV) The red change of the cell walls upon the application of alkali can be seen only under the microscope.

The difference between the color reaction of the infusion and that of the wood is only an optical phenomenon differing with the media. It therefore seems possible that the auxochrome of this darkening is an hydroxyl group which reacts markedly to the chromogen peculiar to "Sugi." The fact that it is somewhat difficult to extract heartwood with water after darkening favors this conclusion agreeing with the general fact that the hydroxyl group is not only effective in coloring the chromogen but also fixes the coloring matter in animal and vegetable fibers.

Much valuable assistance for a satisfactory explanation can be secured from the following experiments which demonstrate the presence of an hydroxyl group in the darkening process:

(I) Litmus-paper inserted in the sawdust of the green "black wood" or closely wrapped in a shaving showed an alkaline reaction when the darkening began.

(II) Some of the same papers were put between boards, including some of sapwood, prepared from green "black wood." They showed an alkaline reaction where darkening had taken place and corresponding in its intensity to the intensity of the darkening. The reaction was most intense on the outer parts of the heartwood where there was a better circulation of air.

(III) The alkaline reaction was not observed in the sapwood of "black tree" or the heartwood of "red tree."

In view of these facts, it becomes evident that all the heartwood of "Sugi" can get the darkening with alkali, and that the darkening of "black wood" is caused by the auxochrome naturally raised in the heartwood on exposure to air while the wood is submitted to prolonged gentle seasoning.

Now let us turn our attention to the nature of the auxochrome and its derivation. It has already been shown by Dixon[16] that the sap of wood contains a good deal of electrolytes, i. e., free ions. The auxochrome under discussion is also the hydroxyl component of the unknown electrolytes. But such a strong basic reaction as is noticeable in the darkening of "black wood" is seemingly to be attributed to ammonia; we carried out therefore the following chemical tests for the identification of ammonia, taking the materials in the form of sawdust:

(I) Distillates from "black wood" were absorbed in sulphuric acid. This solution gave rise to yellow brown deposits with Nessler's solution.

(II) The application of strong alkali or magnesia to the distillation resulted in the rapid evolution of ammonia and increased the quantity of the above deposits.

(III) Two microchemical methods proposed by Molisch[17] for the identification of ammonia gave affirmative results.

These experiments seem to prove that the alkaline reaction attended with the darkening is induced by ammonia usually produced as the final decomposition product of proteids. To investigate indirectly the comparative distribution of proteids and amino acids (the direct decomposition product of the former) among the kinds of wood and the parts of the wood, we made a colorimetric comparison of the sawdust distillates, based on the intensity of the color reaction with Nessler's solution. The material was then treated with magnesia and distilled; and the ammonia so driven off was absorbed in sulphuric acid, giving the following results:

TABLE 6.

	Source of sawdust.			
	Black wood		Red wood	
	Heartwood	Sapwood	Heartwood	Sapwood
Relative intensity of color..	5.0	1.8	1.0	1.0

This result shows that the heartwood of "black wood" can surpass the sapwood especially that of "red wood" in the production of am-

[16] Dixon, H. Transpiration and the Ascent of Sap in Plants, London, 1914.
[17] Molisch, H. Microchemie, Jena, 1913, p. 60.

monia. Although it seems that "red wood" may also be able to evolve ammonia, though perhaps in slight amounts, we must not leave out of account the acidity of the sap, which is to be encountered by the ammonia and which controls in large measure the darkening of the wood. For example, No. 10, Table 3, owing to the marked acidity of its sap (verified with litmus paper) ranged to the group of "red wood," notwithstanding the fact that the same wood was very like "black wood" as well in its appearance as in the content of "particular substance."

In connection with ammonia, some amino acids as the intermediate decomposition product should be found in the wood. Yet, our experiment fell short in verifying their existence beyond the fact that the aqueous extract of the wood showed the tylosin reaction with Millon's reagent. So its complete proof, together with that of the enzym decomposing the acids (desamidase), remains for further investigation.

But it is evident that the conditions necessary for the production of ammonia are the existence of both air and humidity as already shown by experiment. Now considering the standing trees, the excess of air can be supplied to the wood only by means of wounds, which at the same time induce the transformation of sapwood into heartwood. So "black wood" passes through the stage of being normal heartwood and also is produced by a change in the sapwood. Of course, the influence of the wounds upon these chemical changes in the trees may vary with their sizes and other circumstances. Therefore, the heartwood of some trees can more or less go through the process of color conversion, through the extreme influence of wounds, while still standing, whereas in others the conversion may be limited to the wounded parts, depending on the healing of the wounds or the interruption of the excess supply of air by other causes. But the heartwood of the latter, where the decomposition of proteids was intercepted in the middle of the process, can stain on exposure to air as has been described.

INDIRECT CAUSE OF THE DARKENING

As was demonstrated in the previous paragraph, the wounds must be the indirect cause of this phenomenon as suggested by Dr. H. Shirasawa. To confirm this explanation, we carried out many investigations, including young and old trees, in the stands of the districts of Yoshino and Shizuoka. In the young stands where the normal

heartwood had not yet begun to develop, most of the wounded trees had false heartwood of a brown color. This shows that the wounds, being the indirect cause of the formation of the heartwood and its darkening, instigate the transformation of the sapwood into the heartwood and induce at the same time the discoloration of the wood. The results may be summarized as follows:

TABLE 7.

Existence of wound	Kinds of tree			
	Black tree	Red tree	Without heartwood	Total number
Wound present......	73	78	2	153
No wound..........	0	58	7	65
Total number......	73	136	9	218

These figures evidently favor the above view. But such wounds as are not externally visible are not usually found. So we examined carefully five individuals of "black tree" which were suggested by experts in the district of Yoshino to be entirely devoid of wounds. Effective wounds were found however in the interior of the stump of each of these trees. Furthermore, we made a cut with a hatchet, one and a half feet above the ground and extending into the heartwood, on one side of the trunk of 18-year-old "red tree" on the grounds of the Forest Experiment Station, and cut down the same tree after three months. In a longitudinal section of the trunk through the cut, the partial unilateral darkening of the heartwood, extending one foot upwards and three inches downwards from the cut on the corresponding side, was observed on the day after its felling and sawing. Among three 50-year-old trees of "Sugi" growing closely together, only one showed an extreme darkening after its felling and sawing into boards and it possessed a big wound in the stump.

But as is shown in Table 7, not a few "red trees" were wounded as much as "black trees," while many of them, owing to the fact that the phenomenon had only just begun, or was only of local occurrence or weak in intensity, were practically classified in this district as "red tree." The unilateral darkening was often found in the same investigation.

Yet, in these exceptional "red trees" and on the red part of the heartwood of the latter case, the marked acidity of the sap was noticeable with litmus-paper. Therefore, it seems possible that, when the darkening indirectly caused by the wound takes place while the tree is standing or on first exposure to air after its felling, the acidity of the sap and the amount of ammonia produced interfere in the phenomenon in opposite directions, while the quantity of "particular substance" controls the intensity of the darkening to a large extent.

VARIETY HYPOTHESIS OF "BLACK TREE"

It seems to us that there may be in all probability many varieties or forms among the forest trees of "Sugi" besides those varieties known in horticulture, such as *var. elegans* Mast., *var. uncinata* S. et Z., *var. nana* Fort., *var. arancoriodes* S. et Z., etc. But confusion of these possible varieties or forms with "black tree" should be avoided. There is no difference between the young trees of "red tree" and "black tree." According to the reason already provided, all the heartwood can be made to undergo darkening. As is well-known, "black wood" usually deviates from "red wood" in the water content; figures are given in the following determinations of green materials. No. 8 is exceptional (and will be discussed later).

TABLE 8.

No.	Habitat	Kinds of wood	Green material	Water content
			Grams	*Per cent*
1	Tomioka (Shizuoka)...	Black.........	37.96	62.3
2	Utosawa (Shizuoka)...	Black.........	68.30	53.3
3	Utosawa (Shizuoka)...	Black.........	61.32	51.5
4	Ochiai (Shizuoka).....	Black.........	91.06	60.4
5	Ochiai (Shizuoka).....	Black.........	91.06	66.4
6	Ochiai (Shizuoka).....	Red...........	45.42	39.6
7	Ochiai (Shizuoka).....	Red...........	37.06	45.0
8	Utosawa (Shizuoka)...	Red...........	58.46	50.5

Some ecologically different features attributed to "black tree" in some localities are probably due to the wood's high water content. A tendency to be relatively resistant to drying is sometimes noticed in "black wood." As no distinct difference in the stomata, so far as their number and distribution are concerned, exists between "black" and "red" trees, the marked increase in water content of "black wood"

and its behavior in drying are possibly induced by the water adsorption power of the wood, which may be supposed to be further caused by its high content of accessory substances in the heartwood. The increase in the amount of "particular substance" and other organic substances, from which ammonia is derived, serves as an explanation. The extraordinary case found among even "red wood" (such as No. 8, Table 8) also can be explained in the same way, as this material came from the same source as No. 10, Table 3, which also showed an exceptionally high content of "particular substance" for "red wood." But, as the origin of the rich production of such substances in "black wood" and especially that of the marked acidity of the sap, are beyond reach as yet, we presume here conveniently from the general occurrence of the phenomenon, that these matters are indirectly derived from the site. Although the future will probably reveal the exact and precise factors, possibly associated with "black tree" as a variety, it must be related only to the rich production of these substances and the acidity of the sap.

"BLACK TREE" IN RELATION TO SITE, AGE, ETC.

As "black wood" is indirectly caused by wounds, it follows that very many "black trees" are naturally located on the places where trees are apt to get wounds, such as the margins of woodlots, ravines, road and trail sides, stands closely located to dwellings, places where there are rolling stones caused by loosening the rocks, the sides of slides or other roads, etc. Insects and artificial pruning may sometimes cause the effective wounds.

Calcareous, fertile, and swampy lands are apt to produce "black tree." These physiographical conditions, especially soil properties, seem to be largely responsible for the rich production of "particular substance" and other unknown organic substances, in short, "heartwood substances," and subsequently influence the extent and color intensity of the darkening. In this connection, the acidity of sap, which controls the darkening, is also possibly related to the same factors. For example, the extraordinary acidity of sap is the only explanation suggested for the occurrence of the "red tree" which had three points of similarity with "black tree," i. e., wounds, large quantities of both "particular substance" and water (as already shown respectively in No. 10, Table 3, and in No. 8, Table 8) and the similar external appearances of the tree and the heartwood. Although the

acidity of sap not only controls the darkening in extreme cases but is also closely related to the tint of the heartwood of "Sugi" in general, its derivation is quite obscure so far as our knowledge is concerned. A few data will be given for information only.

Among many trees of "Sugi" in certain stands in the district of Yoshino, only one remained as "red tree" in spite of the fact that it had been wounded. The soil about the tree was acid. One stand in the same district, very famous for the production of high quality "red wood" for many reproductions, had a conspicuous acid soil as compared with the other twenty stands.

As the wounds are responsible for the precocious formation of heartwood and at the same time induces its darkening, "black tree" may occur earlier than normal "red tree." The trees once transformed to "black tree" can scarcely return to "red tree" in the course of many years. The darkening taking place on exposure to air after felling and sawing can not be seen, however, in the "black trees" which are over about 150 years old. The staining in such cases is not so deep colored as the darkening in the younger trees; it is generally light, suggesting the gradual fading of the original darkening.

VALUE OF "BLACK WOOD" TO THE TRADE AND SOME PRACTICAL PRECAUTIONS

Owing to its supposed durability, "black wood" is preferred for telephone poles, bridge and ship building, etc. But "black wood" is generally considered of inferior quality for the many other uses, to which it may be put. It is, therefore, of economic importance to prevent the production of "black wood." The only practical method is, of course, of a purely preventive nature. In stands where "black trees" are apt to be produced, care must be taken in the pruning of living branches to avoid wounds of a size effective for the production of "black tree."

So called "seasoning in stands" that is leaving one part of the crown after the felling and peeling of trees, the method prevailing in Yoshino and other districts, is recommendable for such trees of "black tree" as first stain on exposure to air, to avoid the extreme darkening. But it is a fallacy that some darkening substance is removed to the twigs by this means or that this method is effective in inducing "black wood" to turn to "red wood," as believed among the people in the above districts. We found that no coloring substance and especially

"particular substance" is transferred to the twigs by the above operation. As already shown in the course of this article, it means nothing else than that the previous seasoning of the trunk prevents the lumber from darkening, owing to the loss of moisture necessary to cause the evolution of ammonia. In this connection the "girdling" method, usually applied to teak trees in Java, will also be advisable for the prevention of the extreme darkening of "Sugi."

The lumber of "black tree" can be fairly well rid of the darkening on exposure to air if it is submitted to somewhat rapid drying. The stain of the lumber can be removed by treatment with any acid, organic or inorganic; for that purpose vinegar is ordinarily used in Japan. A previous application of acid will also effectively prevent the darkening.

Though many other complicated matters associated with the indirect cause of the darkening remain for further careful investigations, it is evident at least that wounds can induce "black tree." Therefore, the supposition that propagation by seedlings or slips of "red trees" is the sole and safe means of the exclusive reproduction of "red tree," and that "black trees" are a mere variety of "Sugi," is erroneous. The additional precautions given above may be consulted with advantage in this case.

SUMMARY

1. The heartwood of "Sugi" contains some "particular substance" which shows a marked reaction with alkali and is responsible for the darkening.

2. All the heartwood of "Sugi" shows the darkening on the application of alkali.

3. The natural darkening of the heartwood is induced by wounds and directly caused by ammonia evolved as the final decomposition product of some organic substances.

4. The conditions necessary to the darkening are air and moisture.

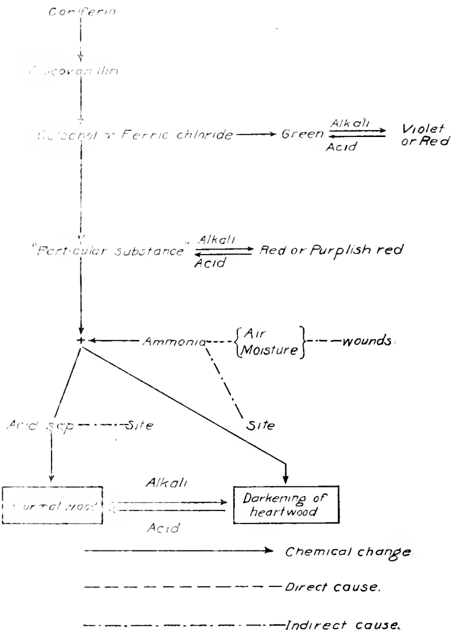
5. Rapid seasoning can prevent the extreme darkening of the lumber.

6. The application of acid removes or prevents the darkening.

7. The acidity of sap controls the phenomenon on the other hand.

8. The whole discussion in this article is represented by the diagram on page 866.

In closing, we should like to express our cordial thanks to Dr. H. Shirasawa, Director of the Forest Experiment Station, and Prof. K. Shibata for their kind suggestions throughout the work. Our best thanks are also due to Dr. W. Terasaki, Mr. S. Moriya, Mr. M.



Koyama, and other staffs of the Station for the kind advice, and to Mr. S. Kitamura and Mr. K. Kano, who have provided us for the present research with many valuable materials or favored us with helpful facilities and conveniences in the actual investigation of the stands themselves.

The hearty thanks of the writer are extended to Prof. I. W. Bailey and Mr. E. S. Anderson, of the Bussey Institution, for their kind assistance with the present translation.

MITSUNAGA FUJIOKA.

VARIATIONS IN NORTHERN FOREST AND THEIR INFLUENCE ON MANAGEMENT

By E. F. McCarthy

The opportunity to compare the forest in the Algoma district of Ontario with that of the Adirondacks brings out several characteristics which indicate a difference in treatment in the early plans for management. The general belief that the northern pulpwood forest is sufficiently uniform in character to permit the formulation of general rules suitable to the region is not borne out in the study of these two sections or two other sections of Canada to which brief reference will be made.

In the Algoma district red spruce does not appear in townships 23 or 24, range 11, or on township 27, range 20, the Goulais and Agawa River valleys where the study was made. Hemlock and beech were not found, even as isolated species, since the range of the former is limited to the shore of Lake Superior at the Agawa River and it does not come up the streams onto the Laurentian formation, while the beech does not go beyond the north shore of Lake Huron. This limitation of range removes three of the more tolerant species which are found in the Adirondack upland forest.

In compensation for the loss of these species, white cedar (*Thuja occidentalis*) takes the place of hemlock on the swamp margins, in the stream courses on the higher ground, and on the higher ledges. Balsam extends up the slopes from the swamps through the mixed type and mingles with the cedar along stream courses in the lower edge of the pure sugar maple type. Balsam reaches up the slopes beyond the white spruce, with which it is associated on the softwood flats and on the mixed slopes, showing greater endurance of shade than the spruce in its younger stages. A good percentage of the mixed type is composed of balsam, white spruce, and paper birch on land which in the Adirondacks would be spruce flat and the lower slopes of the mixed hardwood and spruce, where yellow birch and soft maple are associated with red spruce, balsam, and hemlock.

The swamps of Algoma have a larger percentage of black spruce, and it grows to a larger size than in the Adirondacks. It mixes with

balsam or even with white spruce on wet slopes where the soils are thin and where a bog flora occupies the forest floor. When black spruce is found on the higher, well-drained land it develops into a tree of good size, reaching 18 inches in diameter.

Dry heath land which would grow black spruce and tamarack with some white pine in the eastern forest, has mixed stands of white and black spruce with varying quantities of jack pine in Algoma. The amount of jack pine depends upon the sandiness of the soil, becoming pure jack pine on very sandy sites, similar to the condition found in Michigan.

The abrupt, broken southern slopes of the ridges have an over-study of white pine, while the northern, more gradual slopes are mixed forest, becoming pure maple at the higher elevations.

In contrast to this, the Adirondack types and features are so familiar to the members of this section that a general review of them is unnecessary. Some of the features that are in contrast may be recalled. The Adirondack swamp may be pure black spruce but is usually a mixture of this species and balsam. The flat lands and slopes, having mixtures of very tolerant species, create a dense crown cover which precludes a thrifty advanced growth. Balsam does not go up the slopes into the hardwood land, nor is there much pure hardwood area without a mixture of red spruce, to compare with the hard maple ridges of Algoma. The presence of beech and the maples with the softwoods on the eastern upland results in a forest 200 to 250 years old largely kept in an over-mature condition by its density and the old age of its members before they reach a place in the crown cover. The topography of Algoma is comparatively low with ridges not usually exceeding 1,800 feet, which combined with the deep soils on the north slopes, eliminates the spruce upper slope type of the eastern section, and gives place to the sugar maple type 100 per cent pure over large sections. This factor is important, since the maple type will not carry fire on the ground after nightfall. This fact of practical immunity of the maple type was noted in a 2,000 acre fire in early June, 1920.

The Algoma district studied has certain resemblance to the topographic and climatic conditions of the western Adirondacks. The general elevation is about the same, as is the situation east of one of the Great Lakes. They are different in regard to the direction of storms, however, since the storm path of the summer months is south of the Algoma district, resulting in east to north easterly storms,

while in the other region the storms pass over or north of it, seldom bringing rains from the east or northeast. Judged from the failure of the three species mentioned as not reaching the Algoma region, the humidity is less and probably the growing season is shorter. This is borne out by the occurrence of three frosts in July and two early in August of last year. No data on weather conditions were secured.

Having shown the characteristic differences of the two regions, the effect on management of the forest may be noted.

The black spruce swamps, having a wider range of site, have greater stability than the softwood type of the Adirondacks which contains a large percentage of balsam. This is the pure softwood type in Algoma, becoming more pronounced to the northward as the prevalence of undrained bogs or muskegs supplants the better southward drainage. Among softwoods out of the swamp type, where balsam makes up a large part of the stand, the mortality is heavy in the western forest, due chiefly to the attack of boring insects and weakening of trees by butt and root rot. The forest of the spruce-balsam type is constantly subject to this depletion, even in the virgin stand, and this has resulted in the creation of a young forest, about 100 years old, as compared with an Adirondack stand over twice that age. Due to its open condition, it is growing thriftily, has all size classes well represented, and there is little acute suppression among the young trees. This condition is not duplicated in New York, even in the softwood type. The statement made for the softwood type will hold also for the white birch mixture, while the stand having yellow birch in mixture is not so severely congested as is the case in more tolerant hardwood associations.

Emphasis must also be given to the condition of long, softwood crowns in the Algoma forest, since this factor enables the tree to recover quickly when released. It must also be considered from the point of fire hazard, since low crowns, combined with paper birch and prevalence of balsam increases the risk of destructive crown fires. White cedar, scattered through the forest from the swamp edge to the high ledges, since it is so liable to be hollow, holds fire over long periods and prevents their final extinction. This species is less common in the Adirondack region, and not so fire-resistant as the hemlock which it replaces.

The facts thus presented briefly, point to certain advantageous features in the Algoma forest which may be reviewed from the standpoint of present management.

(1) It has a larger percentage of softwood than the Adirondack region, and this increases progressively to the northward.

(2) It substitutes white for red spruce, an advantage in rate of growth, recovery after release from a stand, freedom from bud worm attack and ability to grow in open position.

(3) The forest has a good gradation of size classes, and is for this reason better suited to the selection system of cutting.

(4) It has no serious problem of tolerant hardwoods among the types that are now producing pulpwood.

(5) The maple ridges act as a fire barrier, and are not of such a character as to induce present cutting.

The disadvantages presented are:

(1) The heavy mortality following cutting. This will probably improve with the sanitation of the forest, as the stand grows faster under continued logging.

(2) Fire risk created by an inflamable softwood type.

The point of interest for future determination is where the line may be drawn through Ontario, separating the red spruce forest from the white spruce. For this reason the conditions around Lake Abitibi are mentioned as discussed by Mills.[2] He reports a stand of black spruce and balsam with a large amount of paper birch mixed through the softwood on the upland. His studies of growth showed a period of severe suppression, however, quite unlike that found in Algoma. While the large percentage of softwood favors selection cutting, the normal rate of growth in the virgin type and recovery in the cut-over type is less in the Abitibi district.

Observations made in Quebec in the vicinity of Cookshire, and also near East Angus where the softwood was cut some 30 years ago, show that the forest similar in character to that of the Adirondacks is in much thriftier condition as its crowns close following the first cutting. Borings made in this section indicate that following a spruce saw-timber cutting, there should follow a second cut in about 25 years, since the crowns will have closed in that period of time and growth will be slowing down. The condition of the stand will of course depend on the amount removed, but the cutting of saw timber did not seriously open even the softwood type. Such lesson

[2] C. R. Mills. Unpublished report produced under the direction of Commission of Conservation of Canada.

can be learned in the forest of the settled portions of Quebec because the cutting is older.

A forest condition perhaps unknown to the majority exists along the coast of the Bay of Fundy, where a high precipitation and humidity has created a practically pure spruce and spruce-balsam forest. The balsam does not extend down to the shore for the last mile or mile and a half, leaving a pure stand of spruce on the slope. In spite of the logging that has gone on here for over 30 years, there is still a good stand, except on the recent cutting and the few places where fire has entered. Even the burns are returning to good stands, and the open cleared fields about St. Martins are coming in heavily to red spruce. A close study of this area will throw some light on the optimum conditions for the regeneration of spruce and fir.

Burned areas deserve more careful consideration since the acreage is now large and promises to be larger. In this respect the forests of western Ontario have the advantage that the fire types of jack pine, paper birch, and aspen promise to develop into timber crops that will be useful. It has been developed by Robertson [3] that the Miramichi burn has come back to a stand of valuable softwood, similar to the original, that it is even-aged though not even-sized, and that the age is nearly equal to that of the burn.

These observations have been offered to support the point taken before that a study of the existing conditions in the northern softwood forest will show quite accurately the range of possibility in regenerating a given tract, and a correlation of studies made, together with climatic data available, will make it possible to define the silvical behavior of the present pulp species sufficiently accurately for our present needs. In this way a beginning of regulation can be made.

[3] W. N. Robertson. Unpublished report on Bathurst Experimental plot, under direction of Commission of Conservation of Canada.

A STUDY OF REGENERATION ON CERTAIN CUT-OVER HARDWOOD LANDS IN NORTHERN MICHIGAN

By P. L. Buttrick,

Assistant Professor of Forestry, Michigan Agricultural College

The summer camp of the Forestry Department of the Michigan Agricultural College was held in the summer of 1920 on the lands of a lumber company whose holdings are in Charlevoix and Antrim counties, Michigan. The camp itself was located in an old logging camp situated in the midst of an old hardwood cutting on a hillside, such as is typical of that portion of the northwestern portion of the lower peninsula of Michigan, where the topography is rough and more elevated than elsewhere in the State. The original forest was typical of the hardwood forests of northern Michigan. It had consisted of an all-aged mixture of sugar and red maple, American, rock and slippery elm, basswood, beech, hemlock, and a small amount of white pine. The stand had probably averaged from 10,000 to 15,000 per acre. The cutting had taken place in the winter of 1913-14, and had been a clear cutting—all that remained standing were a few dead snags and a small number of secondary trees under 8 inches in diameter, which had been left as too small to be merchantable. The majority of them had had their tops injured by the felling of the surrounding trees. There was nothing unusual about all this. Thousands of acres of just such lands have been left in the same region after logging. The unusual thing was that the almost inevitable slash fire did not occur, and the remaining growth was permitted to live and resulting in the beginnings of a second crop which is now a thick brush, some 5 feet high and in a few years if left to itself will in all probability completely re-establish forest conditions on the area. It seemed therefore an excellent opportunity to study the origin and character of the reproduction. This was done by sample plots located more or less at random throughout the area. The plots were taken by students having their first experience in silvical work and therefore were probably less exact than older observers, but from a careful check on their work the writer is confident that their figures are indicative of the actual conditions.

An attempt was made to determine the following points:

(1) The amount, condition, and possibilities of future growth and seed production of the trees left standing after logging.

(2) The extent to which the older hardwood trees had sprouted.

(3) The extent to which younger trees either those cut or those otherwise destroyed in logging had sprouted. Trees below 6 inches in diameter were considered as the younger trees and their sprouts called for lack of a better term, sapling sprouts.

(4) The amount and quality of seedling growth resulting from plants already on the ground when the area was cut off.

(5) The amount and quality of seedling growth resulting from seedings established after the cutting of the stand.

(6) The condition of the ground cover at the present time and its effect upon regeneration.

(7) The condition of the logging slash, the extent to which it interferes with regeneration and remains a fire menace.

The data collected give a good picture of the area as it exists at present and summarized shows: (1) That the trees left after logging show little promise of much future growth and serve very indifferently if at all as seed trees at the present time. (2) That excepting for the basswood the mature hardwoods do not sprout. (3) That the smaller trees cut for lumber or to get them out of the way or destroyed by logging, sprout abundantly and where this class of trees was present even in moderate abundance, the resulting sprouts are numerous and vigorous enough to form a respectable basis for a new crop if their growth is sustained. (4) That except where destroyed by acts of logging a large portion of the seedlings which were on the ground seem able to continue their growth under the new regime. (5) That the seedlings which have come in since the area was cut are mostly derived from wind-blown seeds such as aspen and have taken possession to some extent of the old skid roads and other openings, but have come into conflict in the localities with grass, and brier of various sorts. (6) That grass and briers speedily capture openings and compete more or less successfully with seedlings derived from seed introduced after the clearing. (7) That the logging slash after seven years is still undecayed or even matted down and remains a serious fire hazard.

The following is an analysis of the data secured on the twelve quarter-acre plots reduced to acre terms:

Trees Left Standing.—Number living trees now standing per acre, 31. Number which have died since cutting period, 7. Per cent of sur-

vival, 82. Average height remaining trees, 20 feet. Average d. b. h., 3.5 inches. Classed as in good condition, 56 per cent. Classed as dying, poor, injured, etc., 44 per cent.

Evidently little can be expected of the remaining trees as a basis for a new crop. General observations over the whole tract showed that the conifers, chiefly hemlock, all were dying or dead so that the new stand will be restricted to hardwoods. The only species bearing seed, or showing evidence of having borne seed, were the hemlock and the basswood, although these species were seeding abundantly, no seedlings produced from this seed were found. (Possibly the seed is unfertile.) Some of the other species may later develop into seed-producing trees but they will be of little practical advantage as by that time the area will have been reproduced from other quarters or run wild with weeds and brush.

SPROUT REPRODUCTION

The distinction made between sprouts from stumps of mature trees cut for lumber and smaller trees destroyed in acts of logging taking a stump diameter of 6 inches as the dividing line proved of little value, as, except for basswood, practically no stumps over 6 inches sprouted. Sprout reproduction, except for basswood, was confined to sapling sprouts. The basswood stumps sprouted up to largest size present, that being about 30 inches. The following tabulation gives the essential facts regarding the sprouting capacity of different species:

Species	Average number sprouts per acre	Average number sprouts per stool	Average d.b.h., inches	Average height, feet	Number one-fourth-acre plots
Rock elm.............	493	4+	0.5+	5.7	5
American elm.........	232	3.6	.5+	5.2	5
Basswood	147	7.7	.6+	7.2	10
Sugar maple..........	365	4.5	.5	6.4	8
All species............	1,337	5	.5	6.1	....

The above table seems to show, first, that a fairly adequate reproduction from sprouts can be secured. With 1,300 sprouts to the acre and an average of 5 sprouts to the stool assuming a survival of one-fifth of these sprouts, or one per stool, the stand would contain later in life about 600 standards. Of course no definite conclusion of the ultimate value of these sprouts can be arrived at without a knowledge of their probable growth rate later in life, but they certainly look promising now.

SEEDLING REPRODUCTION

A study of seedling reproduction is complicated by the fact that it consists of at least three classes of growth: (1) Seedlings upwards of two or three feet tall when the area was cut over which became broken or partly broken in logging and have sent up two or more sprouts from the roots. These seedling sprouts average some three feet high and intergrade with the sapling sprouts. (2) The second class of seedlings are those derived from exceedingly small seedlings which have continued their growth under the new condition. They vary from a few inches in height to a couple of feet. (3) The third class of seedlings are those which have come in since the area was cut over. They are derived from seed produced at a distance and brought in by the winds. They consist largely of aspens, and are confined to areas where the mineral soil was exposed by acts of logging, as skid roads, yarding sites, etc.

An attempt was made to secure seedling counts on the plots but the results were unsatisfactory. The students were unable to distinguish with sufficient accuracy the various classes of seedlings or to make reliable counts of such large plots. To secure trustworthy data regarding seedlings smaller plots will have to be chosen and then gone over very carefully.

Some conclusions from observation of the whole tract are worth recording however: (1) No conifers are present in the second growth. Seedlings of hemlock or pine where present in the original forest had failed to survive the radical change in conditions. Although the surviving hemlocks were all producing seed, no seedlings resulted from it. (2) The seedling elms seem better to be able to adjust themselves to the changed conditions induced by cutting than the maple. In the surrounding uncut forest, maple seedlings outnumber elm at least five to one. On the cut area there are approximately three times as many elm seedlings as maple. This last is something of a supposition of course since we are unaware of the exact composition of the seedling growth when the forest was removed. (3) The proportion of weed trees, such as aspen, will not be very high in the new crop since they seem unable to establish themselves among the thick brush of the sprouts, and even in the open spaces they have to complete with grass and briers. Such areas will in many places probably remain open till the new growth surrounding them has re-

established the forest conditions when they may be expected to seed up to more valuable species.

What will be the final proportion of seedlings to sprout remains to be seen, but it is evident that there will be enough seedling growth to prevent the new forest assuming the character of a straggling coppice stand and to form with it a closed stand over the area except such parts as old roads, etc., where little reproduction is found.

GROUND COVER

The radical change from a damp, shady virgin forest to hot, dry cut-cover lands was too great to be endured by most of the ground-cover plants and they have practically disappeared. The absence of the ground hemlock (*Taxis canadensis*) which covers almost as a blanket large areas of the forest floor was particularly noticeable here. This is probably not an unmixed disadvantage as this plant often competes severely with the young seedlings. Grasses and briers of various kinds have come in wherever opportunity offers but apparently only where the mineral soil has been exposed.

LOGGING SLASH

The slash was heaped up roughly in loose scattering piles by the swampers to get it out of the way. Owing to the fact that the area was worked over after cutting for distilate wood the slash was composed of smaller pieces than would otherwise have been the case. It has scarcely begun to rot. The piles still stand from one to three feet on the ground and are hard and brittle. It is difficult or impossible to walk through them. Berry bushes and occasional seedlings have pushed their way up through them but largely they have hindered regeneration. They are still a distinct fire risk, and would afford sufficient inflammable material practically to wipe out the new stand.

CONCLUSIONS

It would be premature to outline a scheme of forest management based on the data here outlined, but if more extended observations show it to be typical of cut-over and unburned hardwood lands, utilization of the sprouting capacity of the stumps in the subordinate stand could probably be taken advantage of in a silvical system.[1]

The Michigan Agricultural College Forestry Department has embarked on a systematic study of this problem and hopes as time goes on to accumulate data leading to definite conclusions.

[1] In this connection see pages 40, 41, and 42 of "The Northern Hardwood Forest: Its Composition, Growth, and Management," by E. H. Frothingham. Bulletin 285, U. S. Department of Agriculture, Washington, D. C.

FOREST SUCCESSION AS A BASIS OF THE SILVICULTURE OF WESTERN YELLOW PINE [1]

By Robert H. Weidman

U. S. Forest Service

Since the beginning of timber sales on the National Forests 15 years ago, the silvicultural system generally used in western yellow pine has been characterized by a selection method of cutting. At the beginning this method aimed to remove about two-thirds of the virgin stand in the first cutting operation. Inasmuch as the virgin forest was uneven-aged and contained a considerable proportion of mature and decadent trees, the silvicultural objects of the method were to cut over the forest rapidly in order to save the decadent timber, to maintain the uneven-agedness by leaving part of the original stand, and to leave an overwood to start and safeguard reproduction. Another object in reserving part of the stand was to have a basis for periodic cuts on the same ground which would come at intervals of one-third or one-fourth of the rotation.

Tentatively a rotation of 180 to 200 years was considered, with cutting periods of 40 to 60 years. Whatever the rotation, it was recognized that the first cut would greatly exceed any of the later periodic cuts. In the case of a rotation of 180 years with three cutting periods, it was considered that after the initial cut each periodic cut at intervals of 60 years would amount to approximately one-third of the total rotational yield. And in this case it was assumed that the managed forest would become one in which there would be three more or less distinct age classes differing by 60 years.

These in general are the ideas which governed the choice of the selection system for western yellow pine. They were based naturally on preliminary studies and observations in the virgin forest. Since then there has been opportunity for thorough study of the results of fifteen years of selection cutting on timber sales, and also of the results of fifty years of cutting on old private areas—cutting which ranged from selection on the older areas to clear cutting on the newer

[1] Paper read before the Society of American Foresters, Berkeley, Calif., August 4-6, 1921.

areas. This further study has revealed much information on the habits of regeneration and forest succession in yellow pine that was not evident at first. It is the object of this paper to present the facts of this study in their relation to the method of cutting now being practiced on timber sales and to the method which it is believed our present knowledge justifies. Only the pure yellow pine forest is considered. The observations upon which these remarks are based were made in Oregon and Washington, but it is believed that the forest conditions found here prevail generally in the western yellow pine region and that the conclusions herein expressed will apply generally, except possibly in parts of the Southwest.

In general the pure yellow pine forest is characterized by open, irregular and uneven-aged stands with a preponderance of mature and overmature trees. In addition there is generally an excellent ground cover of advance reproduction made up partly of dense groups of seedlings here and there in the openings of the forest, but mostly of uniformly distributed and suppressed little seedlings struggling along directly under the overwood. This latter form of reproduction, which has generally been unnoticed, is small and inconspicuous, but has a great power of recovery which, after the overwood is cut, enables it to make a wonderfully dense and even stand of flourishing saplings.

While the virgin forest is very evidently uneven-aged, there is on the whole, and contrary to general opinion, an exceedingly unbalanced representation of the age classes, in which mature and overmature trees preponderate and young trees are only negligibly represented. This was studied very intensively on two 20-acre sample plots on cut-over land in the Whitman Forest, upon which were secured the ages of all the trees above four inches in diameter breast height that had stood on the areas, and the ages of a representative proportion of the tree growth under this size. Upon correlating and averaging the data it was found that of all the trees over 4 inches in diameter, 9 per cent fell in the class 20-100 years, 22 per cent in the class 100-200 years, 45 per cent in that 200-300, 6 per cent in that 300-400, 15 per cent in that 400-500, and 3 per cent in that 500-600. Thus 69 per cent of all the trees above reproduction size were between 200 and 600 years old. This means that only a small proportion of the stand was under 200 years—the maximum rotation age usually considered in yellow pine. On sample plots totaling 417 acres taken in other localities, but upon which the trees were classified by diameter only, it was found that 67

to 74 per cent were over 12 inches at breast height. These figures show very strikingly a relation exactly the reverse of that in a true selection forest where the young trees greatly outnumber the old ones.

This sort of overwood with a fairly abundant ground cover of small advance reproduction is the kind of yellow pine forest the forester has to deal with in Oregon and Washington. From the figures just given showing the scarcity of young trees, it can be easily understood why after selection cutting on timber sales only a rather meager remaining stand is to be found. Representative cruises on the large timber sale cuttings of the Whitman Forest show that the average amount left is 17 per cent by volume of the original stand, or 11 trees per acre 12 inches and over, and 13 trees between 4 and 11 inches, inclusive.

It is important now to consider what sort of a forest this remaining stand after selection cutting will develop into and how the proposed periodic cuts at 60-year intervals will affect it. From old private cuttings, a few of which are already 50 years old, it is possible to get a very good idea what the development will be. The private areas cut-over previous to 20 years ago had practiced upon them a partial cutting method similar as far as the number of trees left per acre is concerned, to the present selection method on timber sales. Thus the old logger's cutting and the present timber sale cutting are comparable in effect. On these old cut-over areas—and there are many thousands of acres of them—there are uniformly dense stands of yellow pine second growth which are practically even-aged. The advance reproduction, in most cases sufficient in itself as a ground cover, has everywhere been filled in with new reproduction, making the cover complete. The cuttings 20 to 25 years old are most extensive, particularly those in the Sumpter Valley near Baker, Oregon, where there are large unbroken areas of thrifty sapling growth about 20 feet tall. The older cuttings closer to Baker contain sapling stands 25 to 30 feet tall and some of these with their remaining trees make the appearance of a managed forest of even-aged second growth with standards. Here and there in the vicinity of Baker, also, are the oldest cuttings in the region, those made by placer miners 50 to 55 years ago. Near Galena, on the Whitman Forest, is an excellent cutting of this sort containing a fine body of even-aged second-growth 50 years old. This is a thrifty stand of small poles having a height of 35 to 40 feet, a maximum breast-height diameter of 12 inches and an average of 5 inches.

This prevailing occurrence of practically even-aged masses of second growth on large areas of old cuttings indicates what will be the future condition of our timber sale areas. If upon these old cuttings the remaining or overwood trees should be removed, the young growth would then absolutely make an even-aged yellow pine forest in the sapling stage. In the case of the 50-year-old miners' cutting near Galena, such a removal of the overwood trees was actually effected a number of years ago—by the early settlers for the purpose of getting conveniently located firewood—and the forest now on the ground is a pure, even-aged stand of poles. With this succession of even-aged young growth after heavy selection cutting on old private areas prevailing so universally, it is safe to expect with the passage of time, the same sort of succession after timber sale cutting. If the future is looked into 60 years hence to the first periodic cut when most of the present overwood will be removed, it is not inconceivable that the liberated underwood will then be a stand of small poles very similar to that on the old miner's cutting at Galena.

The statement that western yellow pine, now almost everywhere a many-aged forest in its virgin condition, will develop after heavy cutting into an even-aged forest will perhaps be difficult for most foresters to accept unchallenged. But there is no doubt of the ultimate acceptance of the idea, for the proof of it already exists. The doubt may be expressed, however, that yellow pine may not continue its even-aged character beyond 50 years, the age of the oldest stands arising from logging in this region. It may be said that shortly after this the stand may open up and gradually take on again the many-aged character of the virgin forest. In proof that this is not the case is an even-aged stand on the Whitman National Forest of 150 years and some 20 acres in extent which evidently originated naturally by some rare combination of favorable conditions. Elsewhere on the National Forests there are doubtless more such small areas of even-aged yellow pine which have so far been passed unnoticed. Several other examples are known in Oregon which have not been studied. And as is generally known the Black Hills region contains quite large bodies of even-aged stands of yellow pine, some of which are of merchantable size.

How is this anomaly of even and uneven agedness in western yellow pine to be explained? Foresters have long known about the temporary types which follow destructive fires such as the aspen type which temporarily supplants Engelmann spruce in the Rocky Mountains.

But they have not appreciated the slow changes in type due to the gradual succession which takes place in plant formations. It has not been until the last decade that a beginning was made in this country to study forest types on the basis of plant ecology. As is known, in the process of plant succession a plant formation undergoes slow changes in which different species gradually succeed each other and the formation works toward an ultimate society called the climax. This can best be illustrated in the forest by the examples in lodgepole pine and Douglas fir. In lodgepole pine, Clements [2] found two more or less distinct types of forest, one a pure even-aged lodgepole pine forest and the other a mixed uneven-aged forest of lodgepole pine, Douglas fir and Engelmann spruce. He found that when the pure even-aged lodgepole pine forest became mature and advanced to overmaturity without suffering from any accident, such as holocaustic fire, other species invaded the stand as old lodgepole trees began to fall here and there throughout the stand in the process of loss through old age, fungous and insect attack. These invaders were not lodgepole pine seedlings, but seedlings of the more tolerant Douglas fir and Engelmann spruce. Lodgepole pine being intolerant cannot well reproduce under its own overwood and, in any event, cannot compete with tolerant species in so reproducing. As veterans in the lodgepole pine overwood gradually toppled over, the Douglas fir and Engelmann spruce filled the openings and in this way a truly mixed and uneven-aged forest of these three species occupied the ground where formerly had been a pure even-aged stand of lodgepole pine. But where the pure even-aged lodgepole pine forest upon maturity suffered a devastating fire, Clements found that a pure even-aged stand of lodgepole pine succeeded to make another forest exactly like the one that had been destroyed. Unless the pure lodgepole pine forest is destroyed by fire or is clear cut by man, it will inevitably, through slow stages of succession, develop into the mixed uneven-aged forest described above which the ecologist calls the climax forest of lodgepole pine. In the case of Douglas fir, Hofmann [3] found that when the pure even-aged Douglas fir forest is allowed to advance to overmaturity without destructive accident to the stand, a similar

[2] Clements, F. E. "The Life History of Lodgepole Burn Forests." U. S. Forest Service Bulletin 79, 1910.

[3] Hofmann, J. V. "Natural Reproduction from Seed Stored in the Forest Floor." Journ. Agr. Research, V. 11, No. 1, 1917. "The Establishment of a Douglas Fir Forest." Ecology, Vol. I, No. 1, 1920.

gradual succession takes place as in lodgepole pine in which, however, the tolerant hemlock and cedar become the invaders and the climax forest is a mixed uneven-aged forest composed mostly of western hemlock and western red cedar. When the pure even-aged forest suffered holocaustic fire at maturity, Hofmann found a succession forest of pure even-aged Douglas fir exactly like the forest that had been destroyed.

In the yellow pine forest, the same law of succession works as inevitably as it does in the lodgepole pine and Douglas fir forests. The effect, however, is less apparent to the eye, because the forest, with few exceptions, remains pure yellow pine. In the arid region in which yellow pine occurs, there is to be found no more tolerant species, in fact, no other species whatever, which can compete with it on its site. Thus for the lack of an invader, yellow pine becomes its own successor, yellow pine seedlings occupying the places vacated by old trees as they drop out of the stand from time to time. The result is the climax forest of western yellow pine—the many-aged virgin forest of pure yellow pine which is so common in this region. If this forest is now removed at one stroke, an even-aged forest will succeed, just as in the case of Douglas fir and lodgepole. The succession, however, has an entirely different source than that of the compared species. Whereas Douglas fir succeeds through its seed stored in the duff and lodgepole, through its seed stored in serotinous cones, yellow pine succession is effected by the cover of reproduction already established on the forest floor. Yellow pine is but an infrequent seed producer; and even after a prolific seed crop an adequate cover of reproduction is never a certainty, because the frequent droughts and late frosts make for but a low rate of survival. The survivals from a number of years of seeding germination and establishment, however, make nearly everywhere in this region an excellent ground cover of advance reproduction—the natural source of the forest which will succeed even-aged when the overwood is removed at one stroke. In this case, the removal obviously cannot be by fire, but must be by cutting alone. And this doubtless explains why over the greater part of the yellow pine region there are so few examples of even-aged stands.

It is clear from this exposition that natural succession in yellow pine can give rise to both even-aged and uneven-aged forests—the latter being the climax forest. What now does this knowledge indicate with regard to the method of cutting? For one thing, it indicates that the present selection method of the Forest Service has been dictated by

the climax form of forest—the form which, because of the conflicting relation of fire, seeding and establishment, has become through the ages the prevailing form of forest. For another thing, it indicates that a clear cutting method may be in entire accord with Nature, if the even-aged succession form of forest is allowed to grow until maturity and then cut so as to reproduce in the same way.

It is almost a dictum among foresters to base the silvicultural system upon the form of virgin forest found on the ground. When the form found is the climax forest, this is not always wise. The foresters of India learned this after 30 or 40 years of experience with chir pine. They found the virgin forest largely in irregular, many-aged stands much as we find yellow pine, and they managed it at first by a selection method. Now they find it better forestry to cut chir pine so as to regenerate it in even-aged masses.

In general a silvicultural method of cutting should first of all be one in agreement with Nature, then one which produces the most profitable growth and which is most practical of accomplishment. It is sometimes stated arbitrarily that the selection forest is the only one which preserves the forest conditions of the site. When a forest by Nature grows even-aged and will repeatedly and vigorously do so on the same site as does Douglas fir, it is safe to say that it maintains the fertility of the site for the purpose of timber production. Indications are that yellow pine will generally do the same thing.

For a forest of pure composition, it may be said in general that it must grow even-aged to produce the most profitable volume growth; because the individuals being necessarily of uniform tolerance, either the smaller trees in the uneven-aged stand are inhibited in growth or the stand is open to permit their free growth, and in both cases the net volume production is restricted. In most regions Nature provides a balance which prevents the restriction of the net growth. Douglas fir is a well known example in which an uneven-aged stand may be had without loss of growth because the more tolerant understory trees of hemlock and cedar are able to grow profitably in the shade of the overwood firs. But as has already been shown, in the arid yellow pine region there is no other species, regardless of tolerance, which will grow on the typical yellow pine site. It would be well if exact figures showing the yield of even-aged as against uneven-aged forests of yellow pine could be given, but until there has been longer experience in forest management this cannot be done. Approximate figures are indicative,

however. The even-aged stand 150 years old mentioned in this paper, if carried to 180 years will give a cut of 48,000 board feet per acre. A yield table for a selection stand in the same locality has been made. In this, the distribution of age classes, the character of reproduction, the accelerated growth of the reserved trees as well as the loss of such trees, has been based upon a study of selection cuttings old enough to indicate what happens. This yield table gives as the sum of three periodic cuts through 180 years 36,000 board feet.

If the silvicultural and management requirements of a species indicate a clear cutting method, then it would seem that clear cutting should be practiced with it generally. It is not good forestry to be committed unalterably to a single method, however. A local forest condition should be managed on its own merits. Where a body of yellow pine is found containing a large proportion of pole age-classes, it would certainly be unwise to sacrifice this profitable growing stock by cutting it clear. Likewise on very severe site conditions it may be wise to maintain a selection forest.

The question now arises, how will the regeneration of the forest be cared for in clear cutting of yellow pine. In the Northwest the generally abundant advance reproduction in the present virgin forest is the already established second-growth. As an insurance against fire, and to seed up openings where they occur, there should be left four or five seed trees per acre which may be retained through the rotation. In the case of the future even-aged forest, more of an effort will be required to secure reproduction. At 180 years an even-aged stand of yellow pine is still young and still growing in too dense a condition to permit of much advance reproduction getting established under it. To secure reproduction it may be necessary to make first a seeding cut of 30 per cent or more of the stand and to allow time enough for a cover of reproduction to get started, such as is now found in the virgin forest. This may require 20 or 25 years, after which the main cutting of the overwood may take place.

In conclusion it may be said:

(1) An even-aged succession forest in western yellow pine is a proven fact.

(2) This even-aged forest is developing extensively on old private cut-over areas and on the more heavily cut of timber sale areas regardless of our intention.

(3) The present selection method is not resulting as intended, in an uneven-aged forest of properly balanced age classes, and it cannot so result.

(4) If it is decided to continue the present method of cutting, it should be recognized because of the constitution of the virgin forest, that the result for a hundred years or more will be a conversion forest in which special cutting or restraint in cutting must be exercised to bring about even a simple balance of the age classes.

(5) Clear cutting, with provision for safeguarding the advance reproduction by leaving scattered seed trees, would be a sound silvicultural system for the Northwest. To practice it would mean, practically, the cutting of but five or six additional trees per acre than are now cut on timber sales, and this would result in leaving the cover of advance reproduction to develop, without overhead competition, into a thrifty second-growth forest.

NOTES ON THE BISHOP PINE (PINUS MURICATA)

By Woodbridge Metcalf

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The bishop pine has been known for many years as an interesting pine species of medium size inhabiting the region in the immediate vicinity of the California coast from Mendocino County south to San Luis Obispo and being found in modified form in Lower California and on Cedros Island. All references which I have seen place the northerly limit of its range in Mendocino County near Inglenook or Fort Bragg and emphasize the moderate size of the tree [1] "usually 40-50 feet, but occasionally 90 feet high, with a trunk 2-3 feet in diameter" with the region of optimum development stated as [2] "the groves of the Mendocino coast flats." One reference [3] states that, "in best situations such as peat swamps and redwood lands it attains a height of from 80 to 150 feet and a diameter of from 2 to 3 feet." The fact that the tree is found as far north as Trinidad in Humboldt County and that it here reaches a size exceeding anything thus far reported [4] will undoubtedly be of interest to dendrologists and foresters.

In May, 1915, while on a trip to northern California my attention was called to some large "bull pines" the identity of which was the subject of controversy in the camps of the Hammond Lumber Company. One of the cruisers voiced his belief that these were "a kind of sugar pine, but different because out of its range," while others said they were "some kind of yellow pine." The tree was easily identified as bishop pine by its long, slender needles occurring two in a fascicle; and its unsymmetrical, persistent cones growing in whorls of three or four around the branches. The cones are of the "closed" or "fire" type, which tend to remain closed for many years on the tree after maturity. The thickened cone scale umbos on the side away from the branch and the slender prickle fixed the identity of the

[1] C. S. Sargent, Manual of the Trees of N. America p. 32.

[2] W. L. Jepson, Silva of California. p. 95.

[3] U. S. Forest Service, Silvical Leaflet 30.

[4] First published report of this extension in the range of Bishop pine in annual report of the College of Agriculture, University of California, 1918-1919, p. 55.

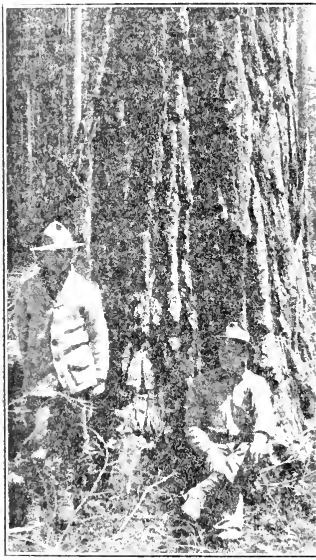
tree beyond a doubt. These trees grew in the Luffenholz Creek watershed about three miles south of Trinidad and from one to two miles from the ocean. They occurred in mixture with Douglas fir (*Pseudotsuga taxifolia*), western hemlock (*Tsuga heterophylla*), and lowland white fir (*Abies grandis*), as an understory beneath a stand of coast redwood which averaged in the neighborhood of 75,000 board feet per acre. The trees examined were standing on an almost level plateau of light sandy loam soil which for several miles in each direction lies below the foothills of the coast range. This plateau is from a mile to a mile and a half in width and at intervals swampy conditions are found due to depressions in its surface or the presence of an impervious layer in the subsoil. Most of the plateau has been cut over in the process of logging operations and is now used chiefly for grazing. It seems evident that the bishop pine occurred in mixture with the redwood and associated species throughout this cut-over area, a mile or more from the ocean, but that it did not in this region occur in the gregarious and strictly littoral stands so characteristic of the species farther south.

The lumber company in attempting to keep the plateau in good condition for grazing has burned over the cut-over area at frequent intervals to destroy brush and tree reproduction. One such fire in 1911 had run for a short distance into the uncut timber so that many of the bishop pines seen were dead or in a dying condition. A vigorous growth of young bishop pine seedlings was coming up on the borders of the cleared area and it is probable that a good stand of this tree would have been present with the redwood sprouts had the area not been subject to the recurring fires. The reproduction seemed to be as thrifty and rapid growing as stands of this species I have seen at Point Reyes (Marin County) and Monterey. The height growth of the seedling shown in the accompanying photograph was found to be over 20 inches during its third year.

These bishop pines are being cut by the Hammond Lumber Company as they come to them in logging operations and are used for car sills in the repair shop and for bridge piling. Recently some of this wood has been used for cooperage by the California Barrel Company. According to A. H. Henderson, who was scaler for the Hammond Company, they cut during the 1915 season about 130,000 board feet of this pine, the trees averaging from 2,000 to 2,500 board feet per tree. He stated that the trees cut during that year were of such good form and so uniform in size that they averaged higher in board-

foot contents than any other tree in the stand except the redwood. The following figures given to me by Mr. Henderson were obtained by him from measurement of the tree from which the foliage and cones in the accompanying photograph were collected.

Total length	166 feet
Merchantable length	96 feet
Stump height	3 feet 10 inches
Stump diameter	41 inches
Diameter upper end of first 20-foot log	37 inches
Top diameter	24 inches
Merchantable volume (Spaulding scale)	4,145 feet, b.m.



A bishop pine near Trinidad, Humboldt County, Calif., 48 inches d. b. h., 170 feet in height.

Large bishop pine with western hemlock and grand fir as understory in redwood forest, Humboldt County, Calif.

During the first five months of 1916 an area of from 60 to 70 acres of timber in the Luffenholz Creek watershed containing a typical stand of redwood, bishop pine, and associated species was cut over. The

following figures, compiled from the scale books by A. H. Muzzall, who was then scaling in this camp, are of interest in showing the size of the bishop pines and their comparative importance in the stand.

Total volume for the area (all species)....................4,234,162 board feet
Volume of bishop pine on same area............131,741 board feet = 3% in vol.
Total number of trees cut and scaled....................................1,373
Number of bishop pine trees...71 = 5%
The average volume of above 71 thees = 1,980 board feet (Spaulding scale)

Range in volume from 1,000 to 4,000 board feet. Using 46 of these trees as a basis, the average merchantable length was 80 feet. Only four had a merchantable length as low as 40 feet, and twelve exceeded 100 feet, the maximum being 116 feet.

The stump diameters of the above trees (inside bark) ranged from 21 to 56 inches, the average for the forty-six being 37 inches.

Counts of annual rings were made on the stumps of eight of the above trees which showed the following age diameter relations:

Stump diameter inside bark *Inches*	*Age when cut* *Years*
25.5	190
25.9	260
27.4	190
30.0	150
40.0	250
44.0	260
48.	250
58.	270

The progress of diameter growth may be approximated from these analyses about as follows:

Age *Years*	*Diameter* *Inches*
20	6.7
40	13.4
60	15.1
80	19.8
100	23.8
120	28.6
140	30.9
160	32.8
180	38.0
200	39.1

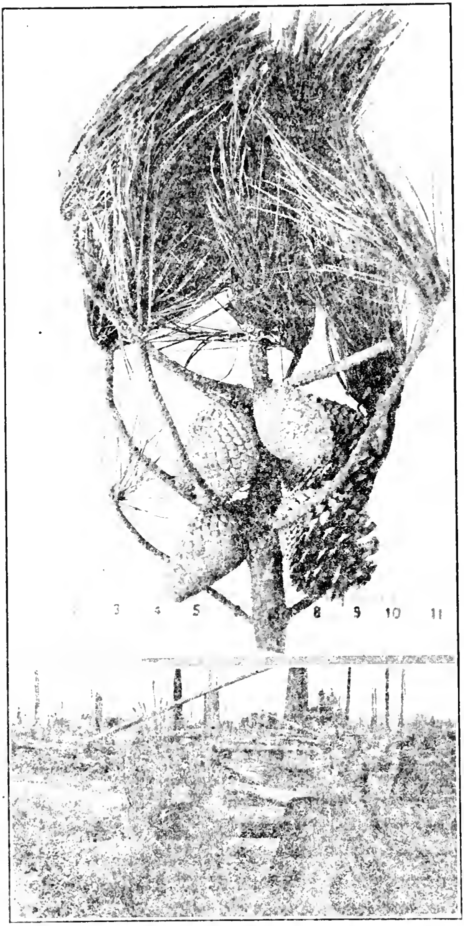
These figures indicate that the bishop pine in the Humboldt County extension of its range is a tree of good proportions and rapid growth, which because of the strength and hardness of its timber, may well be considered for propagation as a secondary species in redwood stands.

GROWTH OF BISHOP PINE NEAR INVERNESS, MARIN COUNTY

As an indication of the more usual growth of the bishop pine, the following figures taken by students in silviculture during November, 1920, may be of interest. A temporary sample plot was laid out in a typical pure stand of this tree on a northeast exposure near Inverness, California. The pine here occupies patches of the slopes of the Point Reyes peninsula on the side toward Tomales Bay and protected from the ocean winds which prevent the growth of any trees on the slopes facing the ocean. The pine of this region is usually found in pure stands on the ridge top or, following severe fires, on the lower slopes. Its gregarious habit is here well illustrated as it mixes very little with other trees found on the peninsula. These include California laurel (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), occasional trees of Douglas fir (*Pseudotsuga taxifolia*), and minor hardwood species. All of the trees when young have excessive competition from a number of shrubby chaparral species which form dense, almost impenetrable thickets. On the plot under consideration there were under the pines a large number of wild huckleberry bushes.

Area of sample plot	¼ acre
Average age of trees	30 years
Range of diameters	3.7 inches–15.8 inches
Average diameter	8.4 inches
Range of heights	34 feet—66 feet
Average height	50 feet
Form factor used 0.45 based on measurement of one tree.	
Number of trees per acre	440
Volume per acre	4,300 cubic feet
Mean annual growth per acre	143 cubic feet

This growth compares very favorably with that of a pure stand of western yellow pine near Meadow Valley on the Plumas National Forest measured in June, 1920, which at 56 years of age showed a mean annual growth of 117.9 cubic feet per year, and is much greater than the growth for western yellow pine in even aged stands at 30 years (W. K. Gallaher, Forestry Quarterly, Vol. XI, 1913, page 533), which is given as 2,800 cubic feet per acre; a mean annual growth of



Top.—Foliage and cones from a specimen of bishop pine (*Pinus muricata*), Humboldt County, Calif.

Bottom.—Thrifty one and four year seedlings of bishop pine, Luffenholz Creek, Humboldt County, Calif., on cut-over land.

93 cubic feet. These computations were based on stands of second growth near Nevada City between elevations of 2,000 and 4,500 feet in the optimum region for *Pinus ponderosa.*

The crown classes in the above bishop pine stand were divided as follows:

Crown class	Per cent of total trees	Average d.b.h., inches	Average height, feet
Dominant	31.7	10.2	60
Co-dominant	23.5	8.6	63
Intermediate	34.1	7.4	50
Suppressed	10.7	6.1	35

SEED EXTRACTION AND GERMINATION

The bishop pine, being of the "closed cone" group of pines, retains a large proportion of its seed for several years after maturity. The following figures are the result of experiments on two lots of bishop pine cones collected in the winter of 1916. The first lot came from the large trees at Luffenholz Creek, Humboldt County; the second lot from a dense young stand 15 to 20 years old on an old burn in the Del Monte Forest at Pacific Grove, Monterey County. As the bishop pine frequently produces two and sometimes three whorls of cones in a season, it is a difficult matter to determine the exact length of time the cones have been held on the tree. With all of the Humboldt cones ring counts were made on a section of the branch immediately adjacent to each whorl of cones. While a few errors may result from this method of procedure due to the presence of false annual rings, it is believed that these have been reduced to a minimum. Owing to lack of time it was not possible to use this method of age determination with the cones from Pacific Grove so that these figures cannot be considered so accurate, but are interesting for comparison.

The oven used for extraction was of sheet iron set on a heavy iron plate over a gas flame. In order to insure the necessary circulation of air, the door was left slightly ajar which caused slight fluctuations in the temperature. It was found that heating for long periods at temperatures from 110 to 125° F. had very little effect and that shorter periods, at temperatures of 160 to 170° F. produced more satisfactory results. During at least one of the heating periods, the temperature rose to slightly over 200° F. which, however, seemed

not to have injured the seed. In the following table the letter M is used to indicate cones just mature, while the figures show the number of years the cones have been held on the tree after maturity. It is to be regretted that more cones of the older ages were not obtained, but these are difficult to find inasmuch as some open during exceptionally hot dry years and many are destroyed by rodents.

TABLE 1.—*Seed Extraction Data.—Pinus Muricata Cones from Luffenholz Creek, Humboldt County, California.*

Age of cones	Number of cones	Average per cone, grams	Dry weight average per cone, grams	Loss in drying, per cent green weight	Number hours required to open	Maximum temperature, degrees F.
M............	60	23.6	19.6	16.8	44	140
M+1.........	60	31.4	27.7	11.8	14½	170
M+2.........	60	32.4	21.6	33.4	8	[a] 150
M+3.........	60	26.9	24.2	9.9	30	160
M+4.........	55	31.4	27.3	12.9	9	130
M+5.........	22	30.2	28.7	5.2	10	130
M+6.........	25	31.3	26.0	10.7	36	130
M+7.........	11	29.0	27.0	7.2	3	170
M+8.........	5	25.8	24.8	3.9	3	170
M+9.........	2	([b])	([b])	([b])	([b])	([b])
M+10........	3	36.6	32.5	11.8	([b])	([b])
M+12........	4	([b])	([b])	([b])	([b])	([b])
M+13........	3	([b])	([b])	([b])	([b])	([b])
Total........	370	29.6	24.8	15.6		

[a] Over 200° for short period when oven was out of control.
[b] Not recorded.

The following figures show comparison of the above lot of cones from old trees with a similar lot from young trees collected at Pacific Grove, Monterey County:

Cones	Average weight per cone green, grams	Number cones per pound	Loss in drying sufficient to open, grams	Percentage of green weight
Humboldt cones...	29.3	11.5	4:5 =	15.3
Monterey cones....	39.2	11.6	6.9 =	6.9

It seems evident from the above that although cones from old trees are much lighter in weight, it is necessary for them to give off a much larger percentage of moisture before the cone scales will open.

TABLE 2.—*Weight of Seed.—Pinus Muricata Cones from Luffenholz Creek, Humboldt County, California.*

Age of cones	Weight of seed and wings, grams	Number seed per gram	Weight of wings		Number of seed		Number seed per pound
			Grams	Per cent	Total	Average per cone	
M..........	11.0	128	2.9	26.4	1042	17+	58,061
M+1........	19.0	124	6.0	31.6	1610	27—	56,246
M+2........	18.0	113	5.0	27.8	1470	24+	51,257
M+3........	13.0	119	2.5	19.2	1253	21—	53,978
M+4........	14.5	113	6.1	42.0	954	17+	51,257
M+5........	8.0	114	2.8	35.0	570	26—	....
M+6........	6.5	93	2.2	33.8	400	16	42,185
M+7........	4.1	89	1.1	26.8	268	24	40,370
M+8........	1.3	40	0.1	7.7	43	9—	18,144
M+9........	1.0	69	0.2	20.0	55	27+	31,298
M+10......	....	....	....	....	35	12—	....
M+12.......	2.0	130	0.8	40.0	157	39+	58,968
M+13.......	2.0	133	0.8	40.0	160	53+	60,329
Average....	[a]0.19	113.5	....	29.2	8017	21.6	51,484

[a] Gram clean seed per cone.

Column 4 of Table 2 seems to show that seed of this species which are retained in cones on the tree, tend to increase in weight for several years; at least down to the seven-year point. In view of this tendency it is rather difficult to explain the extreme lightness of the 12 and 13 year old seed. It may be that most of the cones bearing large seed will lose them during short dry periods more easily than those with lighter seed. It was very difficult to find any considerable number of cones older than 7 years so that the figures for later age classes are not supported by an adequate number of seed.

From the above figures, it will be noted that it requires 2,383 cones weighing approximately 153 pounds when green to produce one pound of clean seed.

GERMINATION EXPERIMENTS

After extraction of this bishop pine seed it was planted in seed beds in the forest nursery at Berkeley to test the comparative vitality of the seed of different ages. The seed from each lot of cones was planted in a series of rows using two hundred seed per row as the unit. The seed from Monterey was planted March 8th; that from Humboldt on April 19th. Counts of germination, loss, etc., were made at frequent intervals during the period of rapid germination and as

often thereafter as was practicable. Both seedbeds were treated after sowing with 0.1 fluid ounce of commercial sulphuric acid per square foot of seed bed area as a preventative against damping-off injury.

TABLE 3.—*Comparative Total Germination of Bishop Pine Seed During 90 Days Including Those Which Died After Germinating.*

Age of seed	Humboldt Co., number tested	Germination per cent	Monterey Co., number tested	Germination per cent
M.............	800	23.8	1,800	54
M+1..........	800	38.0	1,800	75.2
M+2..........	1,000	29.3	1,600	78.6
M+3..........	800	29.5	1,200	54.9
M+4..........	800	32.3	2,000	48.6
M+5...	600	23.1	1,400	78.1
M+6..........	400	31	1,200	54.3
M+7..........	268	36.5	....	....
M+8..........	40	45	....	....
M+9..........	55	30.9	....	....
M+10.........	35	14.3	....	....
M+12.........	157	40.7	....	....
M+13.........	160	36.8	....	....

This table indicates two interesting things:

(1) The germinating capacity of seed from young trees is much higher in general than that from old trees even though the seed has been retained in closed cones for the same length of time.

(2) There is apparently no relation between the length of time seed has been held in the cones and its germinative capacity; inspection of the table indicates this lack of correlation but it is more positively demonstrated by calculation of the Pearson coefficient of correlation, $r = \frac{\Sigma x y}{n 6x 6y}$ in which x and y represent the two sets of values; in the present case x = age of cones and y = germination per cent. The coefficient r not only shows presence or lack of correlation but its magnitude indicates to what extent one set of values is related to the other.

Carl Hartley in a recent paper describes the significance of this coefficient correlation as follows:

"A perfect correlation should result in a coefficient of 1.0 and a perfect inverse correlation in a coefficient of —1.0, while if the subject and relative vary absolutely independently of each other the coefficient should be 0. In actual use neither of these figures will be obtained. In cases where one set of values is absolutely dependent on the other on the face of the figures there will be no need of calculating

the coefficient, which even in cases where the two kinds of values are entirely independent, there will be a certain amount of accidental deviation of the coefficient from 0. The value of the coefficient (r) is, therefore, ordinarily judged from its probable error (Er) which is found by the formula $\lessgtr = .6{,}745 \frac{1-r^2}{\sqrt{2n}}$ King (1914) gives the following rules for interpreting (r):

(1) If r is less than the probable error, there is no evidence whatever of correlation.

(2) If r is more than six times the size of the probable error, the existence of correlation is a practical certainty.

There might be added to the above statements that in those cases in which the probable error is relatively small:

(1) If (r) is less than .30 the correlation cannot be considered at all marked.

(2) If (r) is above .50 there is decided correlation. Common sense as well as the arithmetical relation between the coefficient and its probable error must, of course, be used in drawing conclusions from correlations."

From the figures in Table 3 the coefficients were calculated as follows:

(*a*)	Humboldt seed	Ages classes M to M + 6
		$r = -0.124 \pm .372$
(*b*)	Monterey seed	Age classes M to M + 6
		$r = -0.135 \pm .18$
(*c*)	Humboldt seed	All age classes
		$r = 0.65 \pm .185$

In each case r being much less than the probable error there is evidently no correlation between age of seed and germination per cent. Calculations were made in the case of Humboldt seed for ages M to M + 6 in order to eliminate weakness of the data in the older age classes; also to base the comparison between the two lots of seed on the same age classes.

When the straight line averages for the points in Table 3 are calculated by the method of least squares, lack of correlation is again indicated by the absence of decided slope in the line (fig. 1).

The indicated *decrease* in total germination per cent with increasing age of seed is, according to such calculations, as follows:

Monterey seed	.9 of one per cent per year
Humboldt seed	0.19 of one per cent per year
(Ages M to M + 6)	
Humboldt seed	0.43 of one per cent per year
(All ages)	

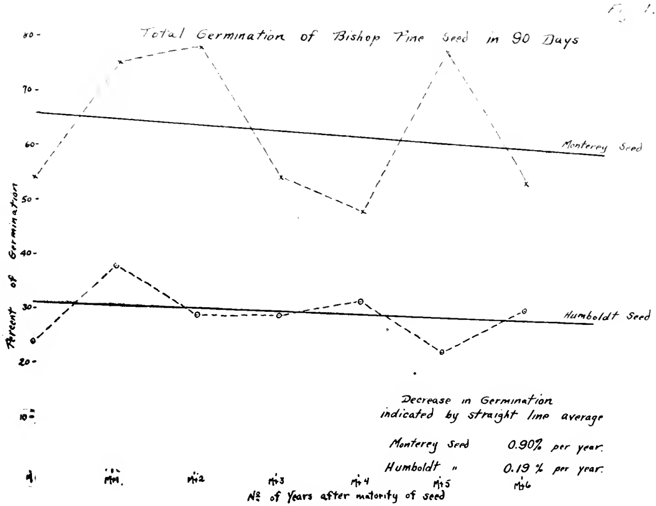


TABLE 4.—*Comparative Percentage of Survival in Bishop Pine Seed Beds After 120 Days from Seeding.*

Age of seed	Old trees, Humboldt County		Young trees, Monterey County	
	Number of seed sown	Per cent producing seedlings	Number of seed sown	Per cent producing seedlings
M.............	800	15.6	1,800	36.9
M+1..........	800	31.6	1,800	56.2
M+2..........	1,000	19.4	1,600	59.6
M+3..........	800	20.9	1,200	45.9
M+4..........	800	26.2	2,000	38.1
M+5..........	600	14.3	1,400	64.2
M+6..........	400	26.2	1,200	45.9
M+7..........	268	20.1	....	....
M+8..........	40	37.5	....	....
M+9..........	55	21.8	....	....
M+10.........	35	20.0	....	....
M+12.........	157	37.6	....	....
M+13.........	160	28.7	....	....

In Table 4 is shown the percentages of healthy trees remaining in the seed beds at the end of 120 days from date of seeding, the percentages being based on the total number of seed planted in each test.

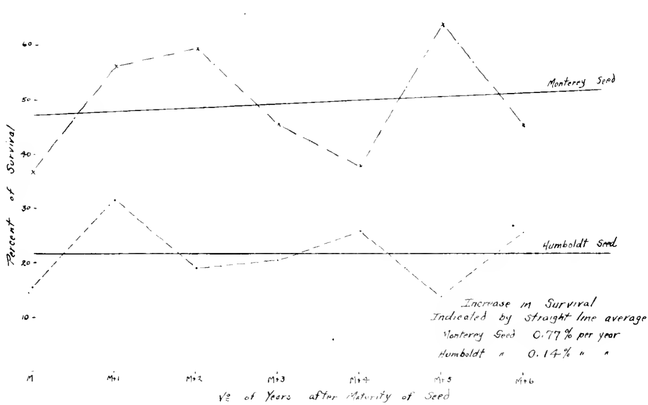
It will be noted in both cases that seed which is just mature is less vigorous than after it has had a resting period of at least one year. The same thing is evident in Table 3 where the total germination is much less in the M age class for both lots of seed than in several succeeding age classes.

The Pearson coefficient of correlation for both lots of seed again shows no relation between age of seed and the percentage of survival when based on total number of seed sown.

In the case of the Humboldt seed for ages M to M + 6 r = .049 ± 25 and for the Monterey seed r = .104 ± 25.

Fig. 2.

Bishop Pine Percent of Survival of Seedlings 120 days



The straight line averages (fig. 2) again show comparatively little slope to the line and in this case there is an indicated *increase* in survival with increasing age of cones as follows:

Monterey seed	0.77 of one per cent per year
Humboldt seed	(M to M + 6) 0.14 of one per cent per year
Humboldt seed	(all ages) 0.75 of one per cent per year

If, however, the coefficient is worked out basing the percentage of survival on the total number of seed germinating (as shown in Table 3) instead of the number of seed sown entirely different results

are obtained. In the case of the Humboldt seed r = —.283 ± .023 indicating a week negative correlation. This means that there is a slight tendency for the percentage of survival to decrease as the age of the seed increases. The Monterey seed shows a much stronger tendency in the opposite direction inasmuch as r = .927 ± .035 indicating that for this seed the percentage of survival of *those which germinate* increases with the increase in time of retention in the cone. The above correlations are evident when the values are plotted on cross section paper. The reasons for this difference in the two lots of seed are interesting subjects for speculation. Climatic differences of the two localities during the formation and retention of the seed may have had an influence but many other factors probably had something to do with it.

TABLE 5.—*Comparative Loss of Bishop Pine Seedlings from Damping Off, Drought, and Other Causes.*[a]

Age of seed	Old trees, Humboldt County seed		Young trees, Monterey County seed	
	Number seed sown	Per cent loss	Number seed sown	Per cent loss
M.............	800	12	1,800	17.1
M+1..........	800	15	1,800	18.9
M+2..........	1,000	12	1,600	19.1
M+3..........	800	18	1,200	9.0
M+4..........	800	12	2,000	9.0
M+5..........	600	16	1,400	13.0
M+6..........	400	19	1,200	8.4
M+7..........	268	13	....	....
M+8..........	40	7	....	....
M+9..........	55	13	....	....
M+10.........	35	20	....	....
M+12.........	157	13	....	....
M+13.........	160	49	....	....

[a] Seed beds in both cases were treated after sowing with weak solution of sulphuric acid. (0.1 fluid ounce per square foot of seed bed area) to check early damping off. Total loss was probably slightly in excess of the figures as some seedlings may have disappeared between dates on which records were made.

Table 5 indicates the comparative loss of seedlings during the summer from damping off, drouth, and other causes. It is interesting to note that the seed from the young trees shows a strong negative correlation between age and loss of seedlings (r = .755 ± .162) while the seed from the older trees shows almost as strong a correlation in the opposite direction (r = .608 ± .159).

This would indicate that seedlings from the Monterey seed showed increasing immunity to loss with increasing age of seed while the reverse is true for the Humboldt seed.

These results are shown graphically in figure 3 in which the straight line averages for both lots of seed were computed by the method of least squares. The computation shows in the case of the Humboldt seed an increase in loss of seedlings with increasing age of cones of .82 of one per cent per year, while the Monterey seed shows a decrease in loss of 1.7 per cent per year.

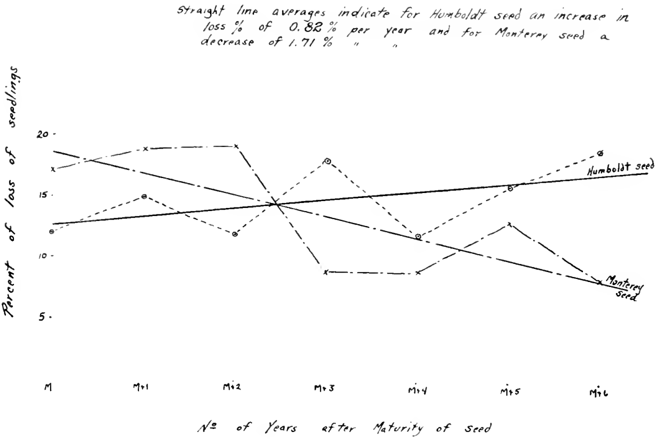
It is again difficult to see why such divergence should exist for these two lots of seed. It is highly improbable that other lots of seed would show the same differences but this again can only be determined by future extensive experiments. If such differences should exist it would be advisable to collect cones of recent maturity from old trees and older cones from less mature trees.

TABLE 6.—*Comparison of Germination of Bishop Pine Seed from Old Trees, Humboldt County, and Young Trees, Monterey County.*

	Humboldt seed	Monterey seed
	Per cent	*Per cent*
Total germination during 90 days. Average of ages M to M + 6	29.7	73.0
Total av. germ. for seed M + 7 to M + 13 years	50.7	....
Average survival at 120 days M to M + 6	21.9	49.1
Average survival at 120 days M + 7 to M + 13	29.7	....
Average loss of seedlings M to M + 6	14.5	13.9
Average loss of seedlings M + 7 to M + 13	20.9	....
Total:		
Germination of seed during 90 days. Average of all ages M = M + 13	38.2	....
Average survival at 120 days. All ages M to M + 13	22.8	....
Average loss of seedlings M to M + 13	15.4	....

Table 6 gives a comparison of the general averages for all ages of the two lots of seed from which it may be seen that the seed from younger trees has a much higher germinative capacity and vitality. The most interesting thing about this table is, however, the fact that the older age classes of seed from the Humboldt trees show so much higher germinative capacity and survival than the seed of the younger age classes.

Bishop Pine — Loss of seedlings Fig. 3.



SUMMARY

1. The natural range of bishop pine (*Pinus muricata*) is extended from Inglenook, Mendocino County, California, to Luffenholz Creek, Humboldt County, approximately one hundred miles farther north.

2. The tree here reaches a much greater size than farther south: 45 inches d.b.h. by 166 feet high. Also the trees average higher in merchantable contents than any other tree in the stand excepting the redwood.

3. The mean annual growth for a 30-year pine stand of bishop pine at Inverness, California, was found to be 143 cubic feet per acre.

4. Short periods of heating at 150 to 170° F. are more satisfactory for extracting bishop pine seed than longer periods at lower temperatures. A temperature of over 200° F. for a short period does not injure the vitality of bishop pine seed.

5. Cones from Humboldt County trees are lighter in weight on the average than cones from Monterey County but must give off twice as much moisture in order to open.

6. Seed from the Humboldt County trees averages 21.6 seed per cone and 51,484 seed per pound. It requires 153 pounds of cones to produce one pound of clean seed

7. For the two lots of seed tested there was absolutely no correlation between the total germination per cent and the age of the seed. Seed from cones 12 to 13 years after maturity showed higher total germination per cent than seed of the younger classes although this seed from older cones is lighter in weight.

8. Seedlings from Humboldt seed showed greater immunity to various causes of loss in the younger age classes; the reverse was true of seedlings from young trees from Monterey.

9. In general a much higher utilization value is indicated for seed collected from young trees at Monterey than for seed from old trees from Humboldt County.

COULTER PINE

By E. N. Munns

Forest Examiner, U. S. Forest Service

Coulter pine (*Pinus coulteri*) is a tree limited in its distribution entirely to California. It is of no importance commercially at the present time, but is of value as a soil cover in regions where tree growth is almost absent, though from a cover standpoint it is not so important as the chaparral species with which it is associated. It will be of great value in the future for forest planting, as it has potentialities for semi-arid regions of poor site conditions and for elevations below the range of the commercial tree species. It has already been introduced successfully into foreign countries. For landscape work the tree is prized because of its habit of retaining a dense, heavy foliage close to the ground when grown in the open.

Coulter pine is not fastidious as to soil. Wherever the tree is able to get a foothold, it will grow, whether on an exposed cliff with little soil covering or in deep soil on level ground. It has been found growing in a loose granitic sand and in all the gradations from that up to a stiff adobe, but apparently does best in a granitic loam. From the locations in which the tree grows, it is evident that it can get along with less soil water than any other tree species of the region, with the possible exception of knobcone pine. The presence of water does not keep the tree out, however, for it grows in meadows where willows alone hold forth, and in creek beds with red alder, sycamore, and cottonwood. In such sites, the tree makes as good a growth as it does on the north slopes at 5,000 feet, where it probably attains its optimum in southern California. Jepson reports the tree as growing in the Santa Lucia Mountains in a canyon not far from redwoods, on a ridge at 2,200 feet with yellow pine, and on the driest and rockiest chaparral-covered slopes with knobcone pine.

Coulter pine is an inhabitant of dry mountain slopes and is found as scattered trees or stands along the Coast Range from Mount Diablo to the Mexican border. In its best development it forms rather open stands at lower elevations than yellow or jeffrey pines, though freely

scattered in the transition zone of chaparral and timber. Along the coast the tree appears at elevations of from 2,000 to 3,000 feet, and in the higher southern mountains reaches elevations of from 6,500 to 7,200 feet.

This pine is usually found in pure stands, though at the higher elevations it mingles with sugar, yellow, and jeffrey pines and white fir, and at lower elevations occurs with knobcone pine, or occasionally with bigcone spruce. In the chaparral stand it occurs chiefly in stands with *Quercus dumosa* and occassionally with *Ceanothus cuneatus,* and rarely with *Ademnostema fasiculatum.* The tree reaches its best development at the edge of the yellow or jeffrey pine belt where it attains a maximum height of from 80 to 100 feet and a maximum diameter of 40 inches. The usual stands are from 40 to 60 feet in height and 18 to 20 inches in diameter. The tree matures at 100 years when the crown begins to flatten out, though while young the tree retains its branches almost to the ground.

Coulter pine bears cones as early as eight years and bears seed uniformly at intervals of from one to five years, though heavy seed years occur at intervals of from three to six years. The seed ripens about the first of September and the cones open slowly, often remaining closed for three years or longer. The seeds are very large and heavy and are not distributed far from the parent tree when liberated. Although the cones remain closed a long period, the seed appears to retain its vitality without much impairment. Fresh seed gave a nursery germination of 95.9 per cent, two-year-old seed gave 94.3 per cent, while of seed obtained from cones which had but partially opened the fourth year, 82.3 per cent germinated.

This characteristic of the tree has an important bearing on the reproduction of the species. As a rule, except on the better sites, one can seldom find seedlings near the parent trees. After a fire in stands with coulter pine, a number of seedlings appear on the burned ground, either from the seed liberated from the closed cones or from dormant seed on the ground. The latter is less likely than the former, however, as the heat from the burning litter probably destroys a large proportion of the seed which escaped rodent destruction. On one burned northwesterly slope where there had been a scattered stand of coulter pine previous to the fire, a series of plots 25 feet square showed that 14.3 seeds germinated per plot the spring following the fire, and 7.6 per plot the following year. All the litter had been burned clean, while a number

of unopened cones were on nearly every dead tree. These cones opened in a few weeks after the fire, and a germination of 84.1 per cent was secured from seeds collected from unopened or partially opened cones. It is quite common in the chaparral to find the coulter pines over a relatively large area to be even-aged, which would indicate that the trees came in after a fire which removed the chaparral cover, either from dormant seed or seed liberated from cones which had opened after the fire.

For the successful germination of the seed, contact with mineral soil is required, as seeds sown at various depths in the heavy chaparral litter have not germinated after four years, while seeds sown in the mineral soil develop readily. As contact with mineral soil is a requisite, this is doubtless the reason why coulter pine seldom enters a stand except after fire has cleared the ground of the litter and herbaceous vegetation.

The seedling grows rapidly both in the shade and in the open, but in the chaparral it does not succeed in competition with the brush cover where the brush is very heavy and where there is an early spring drought. In normal seasons, because of the rather deep root system which is developed early, coulter pine succeeds in becoming fully established and soon dominates the brush.

The growth of coulter pine is exceedingly rapid when the sites upon which it grows are taken into consideration, the development both in diameter and height surpassing that of all of the other species in the region where it grows. The diameter growth is especially rapid and in a number of trees rings better than half an inch wide were observed, but the general average is four rings per inch up to 20 inches diameter on north slopes and seven rings per inch on south slopes.

From over 200 borings and analyses made of coulter pine on the Angeles, Cleveland, and Santa Barbara Forests, the data in Table 1 were gathered.

When growing with jeffrey pine, coulter pine surpasses it in diameter growth throughout its life, while at about 100 years jeffrey surpasses coulter in height.

How fast the tree would grow under plantation conditions is unknown, for it has not been tried out. Lately Los Angeles County has been planting the tree in its roadside work and so far it has done exceedingly well, there being few losses and rapid growth. From the

TABLE 1

Age	North slope		South slope	
	Diameter breast high	Height	Diameter breast high	Height
	Inches	*Feet*	*Inches*	*Feet*
10	1.3	14	0.8	7
20	3.6	21	1.4	13
30	6.3	27	2.4	16
40	9.0	32	3.4	20
50	11.6	36	4.4	22
60	14.2	41	5.5	24
70	16.9	45	6.7	26
80	19.6	48	8.2	28
90	22.4	50	9.9	28
100	25.2	52	11.7	30
110	28.0	54	13.8	30
120	30.1	55	15.7	30
130	32.3	56	17.8	32
140	34.5	57	19.7	33
150	36.6	57	21.8	35
160	38.7	58	24.4	39
180	39.5	58	25.8	40
200	41.0	58	....	..

small amount of such work done so far, coulter pine will probably reach a height of 40 feet in from 8 to 10 years.

Under forest management the tree will be grown in pure stands on a rotation of from 60 to 100 years or more, depending on the situation where grown, to yield from 1,000 to 1,200 cubic feet per acre, the wood being used for fuel and for box material. Clear cutting of the stand is indicated with broadcast burning of the slash to encourage the opening of any closed cones which may be in the tops and to reduce the root competition for the seedlings. Burning in this fashion will keep the rodents down and open up the area so that the seed will be sure to reach mineral soil. As material for fuel wood is in such demand, close utilization of all wood down to a two or three inch diameter will be possible, so that the total amount of débris to be left on the ground will be small, as the market in most cases is adjoining the area where the trees will be grown

THE VALUE OF YOUNG GROWTH ON CUT-OVER LAND

By Swift Berry

Forest Engineer

The problem of determining the amount and value of young growth will be met with by many timber owners, in considering the exchange of cut-over forest lands within the National Forests. Substantial progress is being made in the present Congress on land exchange legislation, and it is probable that the session of this winter will result in the enactment of several such bills covering individual National Forests or States. The provisions of these bills permit exchanges of private land and timber in the National Forests specified for National Forest land or timber within the same State. It is anticipated that the most usual form of exchange will be the trading of privately owned cut-over timber lands desired by the Government as additions to its National Forests for National Forest stumpage to be cut by the operator, which will work out much like buying a tract of National Forest timber under the usual timber sale regulations and paying for it with an equal value of cut-over lands. All exchanges are to be made on the basis of equal values as determined by careful appraisals of both timber and cut-over lands and accepted by both parties. In arriving at the value of cut-over lands the first question confronting the owner is the relation between the value of lands without reproduction and those that have restocked with young growth.

In this connection the description of a field survey made during the past summer by an owner in the California pine region may be of interest. This concern owns about 18,000 acres of desirable cut-over forest lands within a National Forest, where exchanges have been authorized by legislation and where there is an available supply of National Forest stumpage for exchange in return. These lands are so situated that their acquisition would greatly simplify the administration of the National Forest and they are located in an excellent sugar and yellow pine belt as is evidenced by an average yield of 37,000 board feet per acre. The cutting on the area in question covered a period of about 20 years previous to 1921. Before making a formal offer of exchange to the Government the owner desired to have definite informa-

tion as to the condition and distribution of the young growth in order to make possible the consideration of its amount and quality in arriving at the total value to be put upon the lands offered.

Accordingly, a crew of two forest school graduates, working under the direction of the owner's logging engineer, was employed during the past summer in making a detailed field survey of the cut-over lands. The work was done by running lines twice through each forty by means of staff compass and pacing. One man acted as compassman and the other as tallyman, but the two conferred each time on the classification of the young growth. The classification was made by plots each 5 chains square and containing 2½ acres. This made sixteen plots to each forty with four such plots on either side of the two survey lines within a forty. The procedure followed by the crew was to offset 5 chains from a forty corner and then run a compass line for 2½ chains. This point was half-way along a 2½-acre plot on either side of the survey line, and from it notes were made of the condition of the reproduction first upon one plot and then upon the other. If because of topography or young growth it was impossible to see the conditions of the plot from this point an offset of 2½ chains was made to the center of the plot before the notes were taken. Return was then made to the first point, the survey line extended for 5 chains and the operation repeated. All section and quarter corners that could be located were tied into for control, and general notes were taken to aid in mapping. On areas of recent burns where no young growth remained it was found unnecessary to run strips, but the boundaries were mapped and the interiors classified as not restocking with reproduction. Under the average of all conditions on the tract the crew was able to cover about 300 acres per day.

The principal object of the field survey was to classify the land according to the degree of stocking of reproduction. Each 2½-acre plot was therefore recorded as coming within one of three classes, depending upon the percentage of the area covered with young growth, as well stocked, partly stocked, and non-stocked. It was found that some of the well-stocked plots had young growth over 25 or 30 years of age with correspondingly greater value, and these were recorded in a sub-class. The specifications of the classes made were as follows:

I. Class One.—Well stocked.—60 to 100 per cent of area stocked with young growth sufficient to produce a stand of a density equal or better than the original.

1a—Same with young growth on 60 per cent of area averaging 25 feet or over in height.

1b—Remainder of class one.

II. Class Two.—Partly stocked.—10 to 60 per cent stocked with second growth.

III. Class Three.—Non-stocked.—Less than 10 per cent stocked with young growth.

It was found possible with very little additional work to secure considerable other information on the character and quality of the reproduction. Accordingly the estimated percentage of the area of each 2½-acre plot covered with reproduction was recorded together with the average height of the young growth. The species of young growth that apparently would predominate in the next stand was noted. It was found that many sound and thrifty young trees over 12 inches in diameter, breast-high, and capable of producing considerable seed were scattered about the area, and the number situated on each plot was counted. In addition groups of timber of merchantable size that had been left without cutting were cruised.

From the results of this work a map was prepared showing the class of stocking and the average height of reproduction for each 2½-acre plot. The estimated percentage of stocking, age since cutting, and number of thrifty trees over 12 inches in diameter were placed on large sheets for a permanent record. Compilation of the data showed that 16.7 per cent of the cut-over area available for exchange was well stocked, 52.4 per cent was partly stocked, and 30.9 per cent was not yet restocking. In the well stocked class 2.6 per cent of the total cut-over area had young growth averaging over 25 feet in height. The average percentage of stocking, the average height and the average time since cutting were computed for each class from the data for the 2½-acre plots. These averages are shown in the following summary:

Condition of Cut-over Area.

Class	Percentage of total area	Average stocking	Average height of young growth	Average time since cutting
	Per cent	*Per cent*	*Feet*	*Years*
Ia (60-100%)	2.6	74.6	28	16
Ib (60-100%)	14.1	70.6	13	16
II (10-60%)	52.4	28.5	14	11
III (under 10%)	30.9	....	..	..

It is interesting to find on an area in the sugar pine region cut without thought of a second growth, with fire protection largely only from the standpoint of protecting logging operations, and with a high fire hazard from wood-burning locomotives, that about one-fifth of the area has excellent reproduction and in addition one-half has reasonably good reproduction, while less than one-third is without reproduction. The bulk of the class one area is found on the earlier logging operations cut previous to 1908, where small low-speed logging machinery was employed and a large part of the advance young growth escaped without damage. Fire did not follow logging to any great extent and the cutting was not so clean as later and left more scattered trees capable of producing seed. It does not appear that this part of the tract was ever heavily over-grazed by sheep, possibly on account of lack of forage and the advance growth left after cutting. Further, this portion of the area is largely at a lower elevation where reproduction of pine may be easier.

Most of the logging since 1910 has resulted in reproduction of the second class with a fair amount of class one. Larger machinery was installed and yarding done over greater distances and at greater speed. Under these conditions reasonably good young growth was left or would have come in after logging, except for other factors. Fire has been the most important of these, and when occurring after logging has destroyed advance growth and prevented new growth. These fires were not the controlled burning of slash, but were accidental and became very hot before they were stopped. Thus both reproduction and trees capable of producing seed were killed on extensive areas. Another factor in decreasing the stocking of the reproduction in this class was uncontrolled grazing by sheep. In many places adjoining bedding grounds the smaller reproduction has been nipped off either completely or so repeatedly that it is hopelessly stunted. Frequently this damage was sufficient to reduce a plot to the next lower class.

The plots of cut-over land that came naturally in class three made up only a small part of the total. Most of the areas in this class had been burned over after logging and then heavily grazed. One extensive area was heavily burned once or twice after logging with the result that all reproduction and standing trees were killed, and since that time heavy grazing has apparently kept out any seedlings that may have started. The burned area now contains nothing but brush and no seedlings can be seen. Thus it appears that, in the general locality of

this tract, fire after logging followed by heavy sheep grazing is a bad combination, if a second growth of timber is desired. Areas logged by the sky-line system were entirely cleared and most of the larger advance growth felled, which apparently created a very high fire hazard, as they have been burned clean and fall in class three. Areas logged by the high lead system appear to indicate a greater destruction of advance growth and a greater fire hazard than by the former system of ground yarding. In connection with the discussion of the effect of burning it is fair to say that the entire area of one small but heavy fire is covered with excellent reproduction of western yellow pine. Conditions apparently were just right for reseeding after the fire.

Consideration of the above information on the condition of this cut-over tract leads to the conclusion that in figuring on the value of such lands an owner is justified in considering that there is a difference in value between non-restocked lands and lands with reproduction. Class three lands may be considered as bare lands having a certain basic value for the potential growing of timber or for grazing or other uses. It may be described as a value inherent in the land. It is then evident that land with young growth of timber must have this basic land value plus the present value of the young growth.

For example in this case, the class one lands comprising 16.7 per cent of the tract have on over 70 per cent of their area a stand of thrifty young growth averaging 16 feet in height and around 20 years of age. The present value of this young growth depends upon the final return that may be secured when it is cut. Without attempting a calculation of this expected return it is possible to say that thrifty young growth of this character, that has covered about one-fourth of the period before it may be reasonably be expected to be cut, has a considerable value as it now stands. Considering the rate of growth of reproduction in this locality, the progress that seems sure to come in motor truck transportation and the ready market there will be in the San Joaquin Valley for box and common lumber, it is believed reasonable to expect the cutting of young growth of this class by 80 years of age.

The lands in class two have very satisfactory reproduction on nearly one-third of their area. This young growth averages 14 feet in height and probably has an average age of around ten years, or possibly more, as the time since cutting averages eleven years and much of it is advance growth. The difference between the value of this land and that of

class three is the value of the reproduction on about one-third of its area, which has attained a growth of about ten years. The replacement cost has been advanced as the value of reproduction destroyed by fire on Government lands, and it is understood that in certain cases damages have been settled by that measure. On such a basis the value of the young growth on these class two lands would be 28.5 per cent of a reasonable cost of planting carried forward at a low interest rate for ten years. However it is not probable that planting could be done at present with profit in this locality, and probably 50 per cent of replacement cost would be more nearly representative of present value.

Evidence of the value of this young growth from another angle is given by the investment put into second growth by the regulations on National Forest timber sales. In this locality the Forest Service cuts from 25,000 to 30,000 feet per acre from its timber sales. An operating cost of at least 40 cents per thousand is involved in the piling and burning of the brush, with the object of insuring second growth without fire damage. This expense is a direct operating charge on the part of the operator and apparently must reduce stumpage rates proportionately. Consequently it must be considered that with a cut of 25,000 per acre the Government is willing to invest $10 per acre at the time of cutting to the account of young growth. It is believed the reproduction on the class two areas is as satisfactory as that obtained from timber sale areas, and that after ten years the débris has disintegrated to an extent that with reasonable protection the fire risk is not much greater, with the exception that under this unregulated cutting young growth has covered 28.5 per cent of the ground and under regulation it is expected that the entire area will be eventually satisfactorily stocked. Thus it may be assumed that if it is good business to invest $10 per acre in brush disposal on regulated cutting on timber sales the young growth on the class two areas had a value of $2.85 per acre after logging. This would also be in the nature of a replacement value and for the same reasons as above 50 or 60 per cent of the actual investment is believed more representative of value. The extra cost of logging on timber-sale areas involves other items in addition to brush and snag disposal, such as increased construction costs through lighter cut and expense of more careful and lighter logging. These costs are difficult to determine, vary greatly, and may be to some extent offset by the higher average quality of logs cut on a timber-sale area. The point is that the Forest Service believes it good management to invest well over

$10 per acre in second growth. Young growth existing on cut-over land may therefore be reasonably considered as having a material value in addition to the basic value of the land.

In starting the field examination of these lands it was expected to find areas with only fir and cedar reproduction. On the contrary no plots were found in classes one and two having less than 15 per cent of sugar or western yellow pine reproduction. The pines seem able to outgrow the other young trees and it was considered by the field men that this proportion of pine would ultimately give about the same type of stand as the original. Another interesting point brought out by the field survey was the considerable number of thrifty trees over 12 inches in diameter, that will add materially to a second cut and provide seed for further restocking. In that portion of the tract classified as class one, 85 per cent of the 2½-acre plots had one or more trees of this character, and 36 per cent of the plots had at least five thrifty pines per plot. The average numbers per acre for the class one area were 1.1 pines and 1.0 fir or cedar. About 81 per cent of the class two plots had one or more thrifty trees and 20 per cent had five or more pines. The averages per acre were about 0.9 pines and 0.8 fir and cedar.

DISCUSSION

By F. G. Miller

This article touches a vital phase of the land exchange problem. The principle of placing a value on reproduction for purposes of exchange is economically sound, and would encourage regulated cutting on the part of private owners. The chief objective of the land exchange plan is to secure an increased acreage of young tree growth. As Mr. Berry points out, the Government expends money to secure reproduction on its own lands, and why should it not make a money consideration for young growth already established on lands which it seeks to add to its holdings?

The importance of such a policy is shown in the situation as it now exists in the white pine belt of north Idaho. Here, as is well known, the individually-owned timber is protected from fire by various private associations. Since holding for a second cut does not appeal to the membership of these associations as a class, there is a tendency on the part of the members to drop out as soon as their lands are logged off, and thus cease to pay for their protection. These lands are not reverting for the taxes, but are being held with the expectation that they can be

disposed of at some sort of price later. Not a few owners are hoping to exchange their cut-over lands with the Government for timber or other consideration. If it were the settled policy of the Government to place an exchange value on these cut-over lands equal to the base value as land, plus a fair value for any reproduction which they may carry, then the members of the timber protective associations would have some encouragement not only to retain association membership but to adopt regulated cutting methods which would insure the establishment of a new crop at time of logging.

By Geo. W. Peavy

That a hard-headed logger in the West should expend good money for the purpose of ascertaining the value of reproduction on a cut-over area of 18,000 acres, and that professional foresters should be employed to do the work is indicative of the fact that an appreciation of forestry principles, in a small way at least, is entering the minds of those whom foresters have long sought to impress, namely, the practical lumbermen. It is true the approach is by the vital avenue of the pocket-book, but so much the better. Through no other channel will private forestry ever be established, anyway. Mr. Berry's description of the method of covering the ground is interesting. It would appear that the survey was sufficiently intensive for the purpose intended.

While replacement costs may be regarded as reasonably satisfactory as a means of appraising the value of very young growth when a damage suit is involved, or when a sale of cut-over land is contemplated shortly after logging, it does not seem to me a fair or scientific method to employ when 20-year-old stuff, to be managed on an 80-year rotation, is involved even though the replacement cost is carried forward at compound interest at a proper rate per cent. To me "expectation value" is alluring even though it is a prey to all the "economic forces of society." Mr. Berry, who is thoroughly familiar with California conditions, could, as accurately as anyone, set a stumpage value on the final yield, assume a proper "p" per cent, together with appropriate carrying charges, and then eliminate time differences by carrying forward and discounting, thus approximating this rather unstable expectation value. If reasonable data are assumed the expectation value should show the maximum price the owner can expect. The process of getting the expectation value is the same as that employed in case of any property having a deferred income. The greater uncertainty involved in applying

the method to forest properties lies in the greater time intervals before income is realized.

By way of illustration, Class I comprises 16.7 per cent of the tract and 70 per cent of this class is satisfactorily stocked. This amounts approximately to 2,100 acres. Under management with an 80-year rotation this land should yield at least 30,000 feet board measure per acre. Assuming a stumpage value of $20 per thousand, an average protection charge at 10 cents per acre per year, an assessed valuation of $20 for 20 years, $40 for the next 20 years, and $80 for the last 20 years, with a tax rate of 20 mills, and an interest rate of 5 per cent, the present acreage value of the 20-year-old stuff would be $18.64. The $10 per acre planting cost, plus an assumed basic land value of $5 per acre, carried forward at 3½ per cent for 20 years amounts to $29.85.

It does not appear safe to assume that the private owner can carry an investment of this character for less than 5 per cent. If we assume a higher rate the expectation value is lower. It may be objected that the assessed value is too high. However, actual values in stumpage will increase rapidly following the 20-year-old stage. Unless there are decided changes in the administration of the general property tax, the assumed acreage values for taxation purposes may be regarded as moderate. The owner cannot claim the benefit of prospective tax revision. His values must be estimated on the basis of present practices. The annual charge of 10 cents per acre for protection and administration may be high, but a private organization cannot reduce this item materially. What I am trying to point out is that income net, and not cost, determine value. No reasonable economic forecast would seem to justify materially greater values or lower costs than those indicated. Assuming these data then, the owner cannot expect a greater price than $18.64 per acre.

Obviously the owner cannot plead the benefit of the basic Government interest rate in computing a value established by expected income. He has no right to advantages coming from the greater security and efficiency of Government organization as compared with private enterprise. Neither is it apparent that the owner is entitled to a sum resulting from carrying forward replacement costs plus the basic land value at the commercial interest rate. Granting that the replacement cost should be used as the purchase price, the Government, as the purchaser, should pay only that sum for which it can bring the property to its present condition. The purchaser is not concerned with any past

expenses incurred by the owner. The purchaser is concerned vitally with the present value of the property. This position is sound economically; hence if we accept replacement cost as a fair purchase price, we must assume that expectation value justifies it. This is in effect granting that the Forest Service has demonstrated that a certain replacement cost is justified on the basis of assumed returns. In this case we are coming back to expectation value again. My view of the matter is that fixing land prices on the basis of replacement costs is uneconomic and consequently unscientific. At best it is a makeshift, used because of lack of exact cost and yield data. Why not save replacement costs as a means of determining damage awards when very young stuff has been destroyed, and try to approximate values, as they should be, and as in the long run they are, on net incomes?

With his knowledge of the situation, I believe Mr. Berry can take this particular 18,000-acre problem and develop something which will be of still greater use in establishing cut-over land values.

By E. A. Sherman

Mr. Berry's study of this cut-over area together with his findings are very interesting. It would be much more so, however, had he carried further his calculations on the determination of value. He concludes his study at the point where he has determined the approximate price the Government could afford to pay for this tract of land if its only alternative were a replacement by planting with computed protection and carrying costs or reserving seed trees from cutting in current sales with computed protection and carrying costs. It would be exceedingly interesting if Mr. Berry had continued his computations on his Class I lands and shown the returns which the present owner might expect to receive from this young growth at the end of the suggested 80-year rotation, together with the present worth of the land based upon an interest rate satisfactory to the present owner as an investment.

The conclusions reached at the point where Mr. Berry stops are like the flowers that bloom in the spring—appealing, but have nothing to do with the case. Under the law authorizing exchanges, and in accordance with prevailing commercial practice, the only values to which the Government can give weight in appraising such land for acquisition are commercial values. These are most properly reflected in current sales, and upon last analysis are controlled chiefly by the returns which the present owner may reasonably expect, under prevailing conditions to secure from the land itself.

PHYSICAL CONTROLS OF FIRES

By S. B. Show

Forest Examiner, U. S. Forest Service

A previous paper (Notes on Climate and Forest Fires in California)[1] reported on the results of intensive experiments which aimed to determine the effect of certain climatic factors on rate of spread of fires. This report brought out the fact that there was a very specific relationship between rate of spread and wind velocity and moisture content of the litter, and that by experimental methods these relationships could be established.

The present paper is based on work of an entirely different nature. The data used were obtained from the individual fire reports of twelve timber forests in California covering a period of six years, from 1914 to 1919, inclusive. On each individual report, among other things there is given the degree and direction of slope under which the fire occurred. These data were tabulated in connection with an extensive study of forest fires, and an effort has been made to work out the general relation between degree of slope and aspect and rate of spread of fires. The figures derived are therefore general rather than specific in their nature, but it is believed that they represent very closely the relative values which actually exist in general practice. The quality of the data on the individual reports, generally speaking, is good; and it is to be expected that by using very large numbers of individual fires the errors introduced by a few incorrectly reported fires will be largely eliminated. The basis of data is 6,877 fires.

On many of the individual reports the degree of slope is reported as "gentle," "medium," "steep," or "precipitous," using a descriptive term rather than actual degree or percentage of slope. Steepness of slope has therefore been divided into five classes, as follows: level, 0 to 5 per cent; gentle, 5 to 15 per cent; medium, 15 to 30 per cent; steep, 30 to 60 per cent; precipitous, 60 per cent plus.

In tabulating direction of slope, fires on northeast and northwest aspects were grouped with those on north, and similarly fires on southeast, southwest aspects with fires on the south slopes.

[1] Journal of Forestry, December, 1919.

As a criterion of rate of spread, the percentage of "C" fires (those over ten acres in extent,) and the size of average fire have been used. The percentage of class "C" fires is an excellent index of differences in rate of spread on the various slopes and aspects. It is easy to see why this is so. On south slopes, for example, with very dry conditions fires will naturally spread more rapidly than on north slopes where the litter is more likely to be moist than on south slopes, and this greater rate of spread will be reflected in the percentage of fires exceeding a given arbitrary limit of ten acres. For size of average fires the same holds true, the size being controlled both by percentage of "C" fires and the average size of "C" fires, which latter varies in much the same way with slope and aspect that other criteria and rate of spread do.

RELATION OF RATE OF SPREAD TO ASPECT AND SLOPE

Table No. 1 shows percentage of class "C" fires on slopes of different degree and of different aspect. It is to be noted that the percentage of "C" fires increases quite rapidly as the slopes become steeper, the graphic relation approaching a straight line in form. The values on level land are the lowest, as is to be expected. The differences between north and south slopes are particularly striking, while east and west slopes keep an intermediate position and in most cases are fairly close together.

The percentage of "B" fires (one-fourth to 10 acres) is practically constant for all slopes and aspects, averaging 35 per cent (range 33 to 37 per cent) so that percentage of "A" fires (0 to one-fourth acre) is a reciprocal of percentage of "C" fires.

It is to be noted that on the average there are 38 per cent class "C" fires on south slopes as against 21 per cent on north slopes and 11 per cent on level land.

Table 2, based on the same fires as previously used, shows size of average fire on degree and direction of slope. As in the case of percentage of "C" fires, the aspects rank: Level, North, East, West, South. For each aspect the average fire increases directly with percentage of slope, the rates being: Increase in acres per 10 per cent of slope—North, 16 acres; South, 60 acres; East, 33 acres; West, 45 acres.

It is interesting to note that of the total acreage burned (Table 2) 56 per cent is due to south slope fires, only 6 per cent to those on level land, while north, east, and west slopes are about equal.

TABLE 1.—*Percentage of C Fires on Degree of Slope and Aspect.*

Aspect	Slope									
	Gentle		Medium		Steep		Precipitous			
	Per cent	Total number fires	Per cent	Total number fires	Per cent	Total number fires	Per cent	Total number fires	Average per cent	Total number
North	19.0	303	19.0	808	30.0	235	26.0	23	21.0	1,369
South	25.6	476	36.0	1,335	56.8	379	62.2	37	37.8	2,227
East	17.4	218	29.4	514	48.4	126	33.3	9	29.0	867
West	18.8	170	29.3	453	54.7	106	20.0	5	30.5	734
Level	....	....	....	....	....	....	....	..	11.2	1,680
Average	21.4	1,167	29.5	3,110	47.9	846	46.0	74	26.1	6,877

TABLE 2.—*Size of Average Fire on Degree of Slope and Aspect. Size in Acres.*

Aspect	Slope										
	Gentle	Total acres	Medium	Total acres	Steep	Total acres	Precipitous	Total acres	Average	Total acres	Per cent of total acres
North	34	10,250	62	49,605	83	19,590	29	660	59	80,105	12
South	85	40,320	146	194,975	327	124,115	292	10,825	166	370,235	56
East	55	11,995	83	42 605	191	24,045	31	280	91	78,925	12
West	57	9,680	123	55,750	223	23,625	170	850	122	89,905	14
Level	..	......	...	....	...	....	...	......	25	41,500	6
Weighted Average	62	72,245	110	342,935	226	191,375	171	12,615	96	660,670	100
Simple Average	58	......	103	....	206	....	131	......	...		...

The relative average sizes of all fires on the various aspects vary greatly, south slops having the largest and level the lowest.

In Table 2 is also given the average size of all fires on degree of slope alone. Roughly, those on gentle slopes are 2½ times as large as on level land; on medium slopes nearly twice as great as on gentle; on steep, twice as great as on medium. The data for precipitous slopes are very fragmentary and unsatisfactory, only a few fires having been recorded as on such situations.

If the data in Table 2 be platted on degree of slope corresponding to the percentages used, and curved, it will be found that the curves have a slight upward trend, in the same ratio that percentage of slope per degree increases with increase in steepness of slope.

The relations so far discussed are, obviously, very general, and if the data were available it would certainly be profitable to express rate of spread on the basis of forest type instead of aspect. That unquestionably is the manner in which rate of spread will finally be worked out, but at present our data on occurrence of fires are not sufficiently well tied in to timber type to permit of such a division. All that this study claims is an expression of the general relations between aspect and degree of slope and rate of spread.

It is clear enough that on a north slope at low elevation, yellow pine type, rate of spread will be greater than on a south slope, high elevation, in red fir type. At present, however, with no further apologies, the data are presented for what they may be worth.

Work at present under way will establish relative rates of spread in the different timber types in the State.

SEASONABLE DIFFERENCES IN OCCURENCE OF FIRES

Table 3 shows the relative seasonal importance of fires on different aspects. In deriving these figures the total number of fires in a given month is taken as 100 per cent, and the percentage occurring on each aspect was compiled with this as a basis. It is seen that the figures for south slopes are high in May and June, low in July and August and rise again through September, October and November. The figures for east and west slopes are, generally speaking, practically constant throughout the season, while those for the level land show a general tendency to be high in the early part of the season and low at the end. Relative percentage on north slopes rises from May to August and then drops to end of season.

TABLE 3.—*Relative Seasonal Importance of Fires on Different Aspects.*

Month	North	South	East	West	Level	Total	Per cent of total fires
May	14	41	11	6	28	100	3
June	19	35	12	11	23	100	11
July	21	29	12	11	27	100	24
August	23	29	12	11	25	100	34
September	19	35	12	10	24	100	17
October	16	40	14	11	19	100	9
November	11	48	13	11	17	100	2
Per cent of total fires	20	32	13	11	24	100	100

A study of one of the charts made shows what of course everybody knows, that in the early and late part of the fire season a very high percentage of the fires are on the warmer south slopes, and that during the peak of the season the north and south slopes are more nearly equal than at any other time.

Another expression of this same relationship is given on another chart. There are, in the data used, twelve forests for six years, or a total of seventy-two points for each month. If, for example, on every forest and every year fires occurred on the south slopes in August, regardless of the actual number of fires, the value would be 100 per cent of the possible. Likewise, if only twenty-four points were represented the relative value would be 24 divided by 72 or 3 per cent. The values used on this chart are obtained in this way: It is seen that, beginning with May, fires occur over twice as often on south slopes as on north slopes, that through June and July the two approach more and more closely, and that in August they are practically the same; then, during September, October, and November the lines again diverge quite sharply, showing that more and more the fires tend to occur on south slopes. On the average fires occur only 80 per cent as many times on north slopes as they do on south.

A still further and very striking difference between north and south slopes is found in the total number of fires which have occurred during the six-year period. On the north slopes a total of 1,369 fires have been reported and on the south slopes 2,227 fires, or about 62 per cent more. It may be that there is a difference of 10 or 15 per cent in the area of land on north and south slopes in the National

TABLE 4.—*Percentage of Possible Number of Times Fires Could Occur. Basis, 12 Forests—6 Years.*

Month	North slope	South slope	Difference
May	20	43	23
June	65	82	17
July	86	96	10
August	96	97	1
September	82	92	10
October	43	60	17
November	10	28	18
Average	40	50	10

Forests, but we can only conclude that a difference in number of fires as great as 62 per cent is a significant difference. This is due, not only to the fact that fires do not occur so often on north as on south slopes, but probably also to the fact that a considerable number of fires burn out of themselves on the north slopes while this is a comparatively rare occurence on the south slopes. At any rate the wide divergence in the values for the two is too great to be explained entirely on the grounds of coincidence.

In this connection it is interesting to refer back to the paper cited earlier. It was found that fires can not spread if moisture content of litter is over about 8 per cent, and that one season on typical north and south slopes the moisture content was above danger point one-fifth of the time on south slopes and nearly one-half of the time on north slopes. In other words the two entirely independent lines of investigation check in at least a qualitative measure.

RELATION OF RATE OF SPREAD TO COVER CONDITIONS

One exceedingly important control of rate of spread has not yet been discussed; namely, the influence of cover conditions. In the analysis of the fire statistics all fires occurring for three years were segregated into two classes, those occurring in the timber and those in brush. Among the latter were included some fires which were essentially brush fires, although strictly speaking they occurred in timber. In so far as suppression is concerned, a fire in dense underbrush in an open timber stand should be classed with brush fires rather than timber fires and this practice has been followed. As can be seen from the following table, very striking differences in rate of spread were found for the two sets of conditions.

Class of fire	Per cent in brush	Per cent in timber
A	22	47
B	36	35
C	42	18

Under both sets of conditions the percentage of B fires was the same, but on the average there is over twice as high a percentage of C fires in brush as in timber and, conversely, the percentage of A fires is twice as high in timber as in brush.

Years ago Supervisor Wynne worked out comparative rates of spread for fires in brush and in timber and found that, on the average, brush fires on slopes up to 40 per cent and wind velocity up to 8 miles per hour spread 51 acres per hour, while timber fires under the same range of conditions spread 24 acres, or something less than half as much. These two entirely independent lines of investigation give a ratio of about two to one as representing differences between brush and timber fires.

It will be seen at once that one very important reason for the high percentage of class C fires on south slopes is in the greater percentage of brush on such slopes, as compared with north slopes. It has been impracticable to tabulate the data to a point where percentage of C fires in timber and brush on the various aspects can be determined, but there can be no question that character of cover as well as climatic conditions makes the south slope the most dangerous with which we have to deal.

It seems reasonable to suppose that the cause for the occurrence of brushfields on south slopes to a greater degree than on others lies in the fact that weather conditions are more severe there than elsewhere. Once brushfields are established, they themselves tend to continue the difficulty of control of fires and perhaps accentuate the differences between north and south slopes.

Further work, not only on the relative spread of timber and brush fires but of fires in all the cover types, will be necessary to elaborate and complete the study here reported on.

SUMMARY

The study of the influence of degree and direction of slope and of type of cover on rate of spread of fires in California shows:

1. That on south slopes the per cent of class C fires is about twice as great as on north slopes and three and one-half times as great as on level land.

2. That east and west slopes throughout the State occupy an intermediate position between north and south slopes.

3. That size of average C fires and of all fires varies in the same order and about the same degree that percentage of C fires does.

4. That percentage of C fires varies directly with per cent of slope, as does size of average fire.

5. That in the early and late parts of the fire season a very high percentage of all fires occurs on south slopes, while during the peak of the season north and south slopes are about equally represented.

6. That covering a period of years 62 per cent more fires have occurred on south slopes than on north slopes.

7. That on the average fires occur on north slopes only 80 per cent as often as on south.

8. That fires in brush spread more rapidly than those in timber and that this is at least partially responsible for the higher percentage of class C fires on south slopes, on account of greater proportion of brushfields on such sites.

COMMENT ON "FOREST TAXATION"

December 15, 1921.

THE EDITOR, JOURNAL OF FORESTRY,

I read W. G. Hastings' article on "Forest Taxation" in the October issue of the JOURNAL OF FORESTRY with a great deal of interest. It reminded me of a point that I have felt to be very illuminating in studying and teaching forest taxation and that Mr. Hastings did not bring out very strongly.

The assessed valuations for taxation of property in general are commonly based, both in theory and practice, on the market or sale values. And market or sale values are very directly related to the return which the property makes or can be made to make to its owner. Sometimes this return is largely a potential one, as in the case of a man owning his own home—if he did not own it he would have to pay rent for the privilege of occupying it, or if he did not occupy it he could secure rent for it from some other occupant. Usually the return is more concrete and definite, as the produce from a farm or the profit from a mercantile or manufacturing business. As we think over the whole field of the various sorts of property which are used as the basis for taxation we see that almost all of them readily can be and usually are figured as yielding an *annual* return. In the business world in general this factor of the *annual* return has controlling weight, in connection with the risk involved, in determining the sale or market value of a property, and hence the assessed value on which taxes are paid.

When we consider a forest tract for taxation purposes we come to a fundamentally different matter in that we are no longer dealing with an *annual* return, and this is the main point of this note. The return from American forests is a *periodic* one, and the periods are usually very long and more or less irregular. Given the length of rotation, the stumpage value in the future, and the amount of the harvested crop, the annual return could readily be figured, and on the basis of an annual return a commensurate valuation to yield that return per year at some standard rate of interest could readily be worked out and used as the basis for assessed valuation. But the necessary data for this operation cannot usually be predicted far in advance, and some other method of assessment of value must be used.

The commonly accepted criterion for sale value or assessment for taxes of forest lands is the present market value of the land itself *and* the timber crop standing upon it, the latter being usually the larger item. The value of the land is based upon the value of similar land in the vicinity without timber upon it, often used only for pasturage. And the value of the timber, except in very young stands, is ordinarily based on the value of the material in the trees for immediate cutting. This basis of valuation is reasonable enough if the timber is cut at once, for then presumably the return or profit is also secured at once. But more often than not the crop is not harvested immediately, and sometimes not for many years. Under such circumstances the usual methods of taxation work out most unfairly for the owner, as Mr. Hastings clearly demonstrates in his article.

The plan has been suggested of taxing the *land* annually and delaying any taxation of the *timber* until it is harvested, when it is taxed on the basis of the market value on the stump at the tax rate for the year concerned. Some reasonable objections can be urged against this system, one of the strong ones, it seems to me, being in cases of changes of ownership. A sales tax might possibly be devised to apply on every transfer, based perhaps on an estimate of the increase in value of the timber during the tenure of the seller, but in that case it would seem that the final tax should be modified accordingly. Or changes in ownership could be disregarded on the basis of the old warning, "caveat emptor," the buyer taking into consideration the fact that if he harvests the timber crop he will have to pay the taxes upon it.

The whole subject presents serious problems, it is obvious, but it appears to me that any discussion or solution must of necessity take into account the fundamental point that timber lands, particularly unregulated forests (which are almost the only kinds we have in this country), are distinctly different from most business propositions in that their return or profit comes only at very long intervals of years.

Mr. Hastings makes one or two statements which I cannot let pass entirely unquestioned. For instance, he states that a harvest tax "penalizes thrift and good husbandry." Is it not accepted as axiomatic that, with a uniform tax rate, the more thrifty and prosperous and productive are much more easily able to bear their proportionate share of the taxes levied on a community than the slothful and shiftless? And is not this as it should be?

Elsewhere he says that there is perfect accord on the principle that "taxation for revenue purposes should be based on the ability of the individual to pay." If this is the sole accepted basis for taxation we have little use, it would seem, for tax rates or assessments. It is merely a case of "How much have you got? Well, then, give me so much of it." If, on the other hand, Mr. Hastings would emphasize the ability to pay "*because* he possesses that particular piece of property" we would seem to come back at once to the valuation of the property as the basis of taxation.

The author mentions classes of soil in forests as being not more than five in Europe and suggests three as probably enough for any one State in this country. I presume he is referring to "quality of site," as the silviculturists term it, and if so he seems to have overlooked the fact that this is purely a relative term within a definite forest type and that there may be great differences in productivity between sites of Quality I in two distinct forest types.

A harvest tax is simple in actual application in that, whenever any timber is cut, the tax is assessed upon it. It seems just that the man who reaps the harvest should pay the tax when he gets his return from the crop. And it would avoid placing an unreasonable burden upon a timber owner at any time to force his timber upon the market before he was ready to cut it for whatever purpose he might wish. Calling a harvest tax hard names, "fallacious, inquisitive, provocative," is not very strong argument against or condemnation of a system that is just, reasonable, and simple in application.

Yours very truly,

GORDON PARKER.

THE SUPREME COURT OF THE UNITED STATES AND CONSERVATION POLICIES

By E. A. Sherman

Associate Forester, U. S. Forest Service

On November 21 the Supreme Court of the United States handed down a decision which constitutes the ninth consecutive legal victory sustaining a major controverted conservation policy. There have been no defeats. The last victory was in the case entitled Kern River Company et al v. the United States. In this decision the Supreme Court sustains the contention of the Forest Service to the effect that a right-of-way across public lands secured "for the purpose of irrigation" cannot lawfully be used for the development of water power, and that a permit or license for the use of public land for water power development must be secured under the water power laws.

And thus, one by one, the Supreme Court of the United States has set its stamp of approval upon the Roosevelt conservation policies. These policies were each in turn loudly condemned as "unconstitutional," "unlawful," "arbitrary," "confiscatory," and the like, and the men who advocated them or put them into administrative practice were denounced as "lawless" and as placing their own opinions above the law. In the light of the decisions of the Supreme Court, however, the "lawless" ones were those men and special interests who condemned these policies and who smugly based their condemnation upon the law and the constitution.

It is interesting to call the roll of Supreme Court decisions on major conservation policies. It follows:

(1) In the case of Light v. United States the Supreme Court held that under the constitution Congress has a right to determine how the public lands shall be administered, and that the long and uninterrupted use of the public domain by the stockmen conferred no vested rights upon any person and had not deprived the United States of the power of recalling such implied license. Decision May 1, 1911.

(2) A decision in the case of the United States v. Grimaud, and United States v. Inda, held that it was constitutional for Congress to provide a penalty for the violation of the rules and regulations for the

administration of the National Forests and to authorize the Secretary of Agriculture to establish such rules and regulations. It held that the violation of such regulations was an offense and was subject to the punishment prescribed by Congress. Decision rendered May 3, 1911.

(3) In the case of the United States v. Chandler-Dunbar Water Power Company, the Supreme Court of the United States rendered a decision upon which is based the Federal Government's authority to regulate the use of navigable streams for the development of water power. It held that "the title of the riparian owner to the bed of the navigable stream is a qualified one, and subordinate to the public right of navigation and subject to the absolute power of Congress over the improvement of navigable rivers." Also that "under the Constitution, Congress can adopt any means for the improvement of navigation that are not prohibited by that instrument itself. * * * Private ownership of running water in a great navigable stream is inconceivable." Decision May 26, 1913.

(4) In the case of Swigart v. Baker, the Supreme Court upheld the validity of the Reclamation Act of 1902, providing that the cost of maintenance as well as actual construction may be charged against the property benefited, thereby maintaining the integrity of the reclamation fund so that it will be paid back in full and used in subsequent projects without diminution. Decision May 26, 1913.

(5) In the case of the United States v. Midwest Oil Company the Supreme Court sustained the practice of the withdrawal of public lands, both mineral and non-mineral, from private acquisition by the President without special authorization from Congress even though the lands may have previously been open to occupation. Perhaps no other conservation activity was so widely denounced as unlawful as the practice of making withdrawals of natural resources in the public interests. According to the decision of the Supreme Court, it *was* lawful for the President to make such withdrawals and unlawful for his critics to disregard them. Decision February 23, 1915.

(6) In the case of the Utah Power and Light Company v. the United States the Supreme Court sustained the right of Congress to regulate the use of lands of the United States, and that such right could not be diminished by the State in which it was situated providing for their use for private or quasi-public purposes under State laws. This was a water power case and further sustained the contentions of the Forest Service to the effect that permission for the use of National Forest lands for power purposes must be secured under the Act of February 1, 1905, and is not granted by preceding acts authorizing the use of public lands for reservoirs ditches, and canals for irrigation. Decision March 19, 1917.

(7) In the case of the Chicago, Milwaukee and St. Paul Railway Company of Idaho v. the United States the Supreme Court held that the railroad company, in order to secure a right-of-way through the

forest, must execute such stipulations as may be required by the government respecting the use and enjoyment of the privilege granted, the prevention of forest fires, and compensation for timber cut down or destroyed, or for other injuries done to the reservation. Decision June 4, 1917.

(8) In the case of Cameron et al v. the United States the Supreme Court held that the land department of the United States government is empowered to determine whether or not a mining location is valid, and if found invalid to declare it null and void. This case involved mining locations controlling strategic points in what is now the Grand Canyon National Park. Had the contentions of the claimant been sustained it would have been possible through misdirection of the mineral laws to prevent the reasonable administration by the government of any National Park or National Forest.

(9) Now comes the decision in the Kern River Company case, another instance where a powerful water power company has attempted to use the public lands for private profit without charge. Again the Supreme Court has sustained the contention of the conservationists.

Isn't it about time to forever lay upon the shelf this contention of "unlawful interference with business interests?" The foregoing record shows conclusively who has upheld the law and who has defied it or tried to break it down.

REVIEWS

Silviculture of Indian Trees. By R. S. Troup, M. A., C. I. E., Professor of Forestry, Oxford. Oxford University Press, Oxford, England, 1921. 3 volumes. Pp. 1195. 490 figures. Colored map of average annual rainfall in India.

This epoch-making work, the result of years of research into silvicultural problems at the Imperial Forest Research Institute, Dehra Dun, and at other experiment stations and on public forests throughout India, deals with trees "mainly from a silvicultural point of view." There is included, however, botanical descriptions, and drawings of seedlings of many species; these latter data were included because of the importance of the development of the seedling in determining the success or failure of regeneration. As might be expected, the data on individual species vary from a few paragraphs for those that are of slight importance industrially, to tree studies of the principal timber trees comprising from 50 to 80 pages. The enormous amount of data presented may be gauged from the fact that the actual printed page is 8 by 5 inches and that there are almost 1,200 pages in the three volumes. To really study and digest all the material presented would take from three to six weeks of the usual working day. Consequently, the reviewer does not claim to have read the entire work. The introduction of over 50 pages gives a survey of the climate of India, forest vegetation by types and subtypes, ecological factors, soil conditions, natural reproduction, invasion, succession, and gregariousness, silvicultural treatment and conclusion. Acknowledgements are made to those who collaborated.

To the American forester the genera of chief interest are Shorea (which resembles the chestnut oak of New England), the Dalbergia (which has been largely planted in the Changa Manga plantations), the Eucalyptus, the Tectona (perhaps the most important timber tree in India), and the genera of the temperate zone, including especially Quercus, Pinus, and Abies. To those teaching tropical forestry this book will be of immense value. Any silviculturalist making a study of tree species throughout the world will find much of value and interest. It is unfortunate for comparisons with American species that the mensuration data are given by girth classes instead of diameter and

by cubic feet instead of other equivalents. To illustrate the immense amount of data presented, let us turn to the Teak (Tectona Grandis, pp. 697-769). The study of this species includes its silvicultural characterists, general distribution, climate, topography, geology and soil, local occurrence and types of forests in Burma and elsewhere, leaf shedding, flowering and fruit germination with a very detailed description of the seedling, silvicultural characterists, natural reproduction, divided into (1) spread of seed; (2) factors influencing germination; (3) temperature; (4) soil aeration; (5) burying of the seed; (6) combination of factors; (7) factors influencing the survival of seedlings, as to light, soil aeration, soil moisture, weed growth, grazing; (8) some examples of natural reproduction; (9) artificial reproduction, including particulars of some teak plantations in various parts of India, choice of site, spacing, preparation of seed, covering of seed, nursery treatment and transplanting, transplating natural seedlings, the Burma Taungya system, broadcast sowing, dibbling, tending of teak plantations, mixtures in plantations; (10) silvicultural treatment divided into coppice systems, high forest systems, etc.; (11) statistical, in which are included growth data, yield data, volume figures, etc. It will thus be seen that the book is written more from the silvicultural viewpoint than from the viewpoint of the botanist, a radical change from former works of this general nature. The best methods of European silviculture are herein applied to British Indian species. The tree studies of important species give much more local detail than do the commercial tree studies published by the Forest Service in the United States. For our commercial tree studies are largely condensed and the reading matter sifted and arranged to a much greater degree than is done in these volumes. From the scientific standpoint, Troup's work will be of lasting value as a reference work from the mere fact that it contains such an enormous amount of detailed data. Its main weakness, judged from the viewpoint of the forester, is lack of systematic and detailed growth data, especially for those species which can be studied only by means of permanent sample plots.

This book should unquestionably be in every forest library since it will prove to be the greatest work of its kind on species growing in British India. Its value as a reference work will not be confined to the mere description of the species themselves because in addition it contains a vast amount of sound silviculture of direct value to foresters practicing forestry in the United States. Anyone engaged in silvical

research should study the monographs on the following Indian species: Sal, teak, chir pine, blue pine (very similar to the white pine of North America), deodar and spruce. Such a study will give a short course in British Indian Silviculture, which has made great progress during the last twenty years. T. S. W., Jr.

Anatomical Characters and Identification of Formosan Woods With Critical Remarks from the Climatic Point of View With 300 Micrographs. By Ryozo Kanehira. Bureau of Productive Industries, Government of Formosa, Taihoku. 1921. Pp. 317, Plates L.

This is one of the most complete works on the structure of any large group of woods that has ever been published. The wood of 386 species is described in great detail, and keys to facilitate their identification as well as reproductions of 300 photomicrographs are included.

Formosa is the southernmost island of the Japanese Empire. It is traversed by the Tropic of Cancer, which means that it is nearer to Manila than Tokyo. It has an area of 13,890 square miles, which is equal to the combined area of Massachusetts, Connecticut, and Rhode Island. Eighty per cent of the island is forested. The interior of the country is mountainous, with peaks rising over 12,000 feet above the sea. Between the mountains and the ocean there are extensive plains which are largely cultivated. The forests are confined principally to the interior. On account of the steep slopes and savage peoples in the mountains very little utilization has so far taken place.

Because of the wide variation in altitude the flora of Formosa is very rich and may be divided into four zones: (1) tropic, (2) warm, (3) temperate, and (4) frigid, according to elevation. The tropic and warm zones are characterized mostly by broad-leaved evergreen species, and the temperate and frigid zones by coniferous species. In all, 169 families, 1,185 genera, 3,608 species, and 78 varieties of trees have so far been found on the island. Slightly over one-third of the tree species are endemic. Among the epidemic species, those of China, Japan proper, India, and Malaya are strongly represented, while out of 998 species studied only 5 per cent are also found in the Philippines. The Dipterocarpaceæ, which is the principal family of the Philippines, has no representative in Formosa.

In the chapter on the anatomical characters the general characteristics of each family are given, and these are followed by a similar description

of each species. The characters described for hardwoods are size of tree; color of heartwood; width of sapwood; distinctness of annual rings; presence of pith flecks or other abnormalities; number of pores per square millimeter; outline of pores on cross section; arrangement of pores; length of vessel segments; nature of perforations; nature of pits; diameter and thickness of walls, and length of wood fibers; distribution of parenchyma; height and diameter of rays; color of water abstract and presence or absence of flavone. The descriptions of the wood of the gymnosperms are modified to suit the difference in structure, but like those of the dicotyledenous species, represent a vast amount of work, especially microscopic measurements.

The key for identification is so arranged as to show differences between species as far as possible, but in some cases several species, and even several genera, are included in a group without further subdivision.

A chapter entitled "Summary and Critical Remarks from the Climatic Point of View" discusses the following: Occurrence of flavone, fluorescence of water extract, lamellated pith, ripple marks, intercellular canals in dicotyledonous woods, vessels, wood fibers, wood parenchyma, pith rays. At the end of this chapter the author gives the following summary based on a comparison of Formosan woods with those of tropical (Philippine) and temperature (Japan) climates:

SUMMARY

1. Investigation of flavone content in wood is very important for diagnostic purposes.

2. Ripple marks occur more frequently in woods of the tropical zone than in those of the temperate zone.

3. Intercellular canals occur only in woods of the tropics.

4. Number of pores per unit area gradually decreases toward the tropics but the diameter of pores follows an inverse course; in other words tropical woods are coarser in texture than those of the temperate zone.

5. Scalariform perforation of vessels occurs more frequently in the tropics than in the temperate zone; this shows that tropical trees to be of higher order.

6. Spiral thickenings in vessels occur more frequently in the temperate zone than in the tropical zone.

7. Ring-porous woods are more numerous in the temperate zone than in the tropics; in conformity with a higher percentage of deciduous trees.

8. Wood fibers have usually thicker walls and larger diameter in tropical woods than in those of the temperate zone.

9. Metatracheal parenchyma is more frequent in the tropics than in the temperate zone. A. K.

Identification of the Important Japanese Woods by Anatomical Characters. By Ryozo Kanehira. Bureau of Productive Industries, Government of Formosa, Taihoku. 1921. Pp. 104, Plates IX.

This is a supplement to "Anatomical Characters and Identification of Formosan Woods with Critical Remarks from the Climatic Point of View With 300 Micrographs," by the same author. He describes 181 Japanese species in the same detail as he did the Formosan woods. A key for identifying woods by their anatomical structure and 54 reproductions of photomicrographs are included. It does not include all the economic woods of Japan, and a few included from neighboring islands. A. K.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Teak Management in Java

In his enforced leisure as a prisoner during the World War, Supervisor I. Nirschl summarized his extended experience in the Dutch East Indies in a book entitled "Die Forstwirtschaft in Neiderlandisch—Indien."

The Dutch control over 736,000 square miles in the East Indies, or an area equal to approximately three times the size of Texas. But the island of Java with the capital at Batavia and its dense population is the most important single unit of these Dutch tropical possessions. The density per square mile is over 700 which puts it on a par with such closely settled countries as Belgium. As a consequence the forest plays an important role both as a source of fuel and building material and as a protection to the headwaters of the streams needed for irrigation.

Of the three timber types, teak and acacia on the lower slopes, bamboos and vines on the middle slopes, and oak, laurel and conifers on the upper slopes and ridges, the first is the most important commercially both on account of its accessibility and because it is there that teak grows. This species is valued at home and abroad. Its durable wood is of medium weight and hardness so that it is comparatively easy to work. The fear of exhausting the natural supply led to the introduction of forestry in 1849 and Dutch foresters have been notably successful in its culture. The commonest method is to sow the seed after the soil has been used for two or three years for such cultivated crops as pepper, tobacco, tea, etc. Seventeen thousand acres are reproduced annually in this way at an average cost of $9 per acre. In the first year the seedlings reach a height of 2 meters. The maximum diameter and height growth are 30 inches and 120 feet respectively while yields of 70,000 board feet per acre have been recorded. The average stand per acre is less than 200 board feet, however, taking natural as well as artificial stands into consideration. The natural regeneration of teak is uncertain because the seedlings have difficulty in

getting their roots through the thick layer of leaves which fall during the dry season, and are furthermore subject to keen competition from other species.

In spite of its isolation the life of the technically trained man has its compensations. The government is committed to a vigorous policy on its holdings and they make up the larger part of the forest resources of Java. The technical force numbers 93, including the staff of the experiment station, and is reinforced by 1,412 native helpers. The supervisor is the local autocrat and is furnished with comfortable quarters and suitable means of conveyance. Everything considered, the life has distinct attractions and is recommended strongly to young Swiss foresters. K. W. W.

Über Niederlandisch—Indiens Forsten und Wälder. Schweizerische Zeitschrift für Forstwesen. August, 1921.

SOIL, WATER, AND CLIMATE

The Forest as a Regulator and Generator of Waters

Forests affect the regimen of the waters in two ways: First, by making their flow more regular, and second, by increasing their abundance through dews and mists which are deposited in considerably greater quantity on the foliage of trees than on the bare soil. The first of these influences has been scientifically demonstrated by the researches of the Swiss Forest Experiment Station and by other investigations so as to refute the objections of the most skeptical. It was well illustrated in 1875 by floods in the Onne and the Pique, two adjacent streams the watersheds of which are practically identical in all respects except that the former is only about 5 per cent and the latter about 40 per cent forested. The Onne increased its discharge with great suddenness and violence from 11 to 130 cubic meters and caused a damage of several hundred thousand francs; while the Pique increased its discharge much more gradually from 8 to 46 cubic meters and caused a damage of not more than 6,000 francs. The influence of the forest in increasing the abundance of waters was carefully investigated some sixty years ago by a prominent engineer who reported that the discharge of springs is twice as much in forested as in deforested areas, and that reforestation can increase the discharge of springs by 7 meters per day for every hectare reforested. Subsequent investigations by the Central

Association for the Management of the Mountains have shown that the amount of water deposited by dews and mists in suitably forested watersheds sometimes exceeds that coming from rainfall. Long and laborious studies will be necessary to determine precisely how the condensation of this water and its absorption and penetration into the soil are affected by site, species, and other factors, but the general principle is well established. For example, in the two streams already cited, it seems fair to assume that the much greater annual discharge of the Pique (1,732,000 cubic meters per square kilometer as against 693,000 for the Onne) is due solely to the fact that the watershed of the former is 40 per cent and of the latter only 5 per cent wooded. If this is true, it can be calculated that in this region the amount of water coming from unseen condensations in the forested areas is five times that coming from rainfall, and that reforesting one-third of a watershed would double the discharge of its waters. It is thus possible by reforestation to increase considerably our resources of "white coal," lack of which during the war hindered the manufacture of munitions, prolonged the duration of hostilities, and still hinders the economic recovery of France. How urgent it is to replace the forests destroyed by the war and to reforest the mountains is evident. S. T. D.

Descombes, Paul. *La forêt régulatrice et génératrice des eaux.* Rev. Eaux et Forêts, 59:139-142, 1921.

SILVICULTURE, PROTECTION, AND EXTENSION

Protection of Private Forests in Belgium

Of the 520,070 hectares of forest land in Belgium the State owns 38,850 hectares, or 7 per cent; communes 166,750 hectares, or 32 per cent; public establishments 7,840 hectares, or 2 per cent; and private owners 306,630 hectares, or 59 per cent. The Belgian forest code of 1854, unlike the French, imposes no restrictions on private owners, who are free to manage, exploit, or clear their forest lands as they please. This freedom has recently led to such disastrous exploitations as to jeopardize seriously the public interests. A law has therefore been proposed which would authorize the king, on recommendation of a committee of seven appointed by the Minister of Agriculture, to set aside as "protected forests" privately owned tracts which are of special public interest because of their esthetic, hygienic, or hydrologic value. In these "protected forests"

no clearing, clear cutting, or other extraordinary cutting not covered by the working plan or by the usual practice of the owner would be allowed without authorization of the Minister of Agriculture, except in the case of windfalls and dead trees. Where no working plan exists, the cutting of more than one-fourth of the total volume is broadleaf or coniferous high forests, or of more than half the volume in coppice under standards, would be prohibited without similar authorization. In compensation for those restrictions the State would protect the forests from trespass, and on the request of the owner would, without charge, supervise their management in the same way as it does the communal forests. Pending through consideration of these proposals a provisional law was passed, effective from January 28 to November 1, 1921, authorizing the Minister of Agriculture to prohibit clear cutting of forests the preservation of which is of special public interest from an estheic, hygienic, or hydrologic standpoint, except in coniferous stands where the cut-over area belonging to a single owner will not exceed 25 hectares, and in coppice under standards where the volume of the latter does not exceed 25 cubic meters per hectare. The application of similar provisions in France, where the present forest code does not prohibit clear cutting but only complete clearing, would prevent the abusive exploitations which are now unfortunately too frequent.

S. T. D.

Billet. *La protection des forêts particulières en Belgique.* Rev. Eaux et Forets, 59:197-205. 1921.

Forest Information from the Prussian Solling

The author as an introduction describes the geology, climate, forest, the hunt, and chief administrative features of the forest-inspection district of Hildesheim-Solling, which includes 27,198 hectares of State forest and 6,637 ha. of corporation, etc., forest and the surrounding State forests of Northeim, Moringen, and Einbeck (approximately 2,200 ha.), which comprise the territory in which he lived during 44 years of his forest experience. The forest in this district is 60 per cent beech, 30 per cent Norway spruce, and 10 per cent oak. The principle object of management is to perpetuate the beech, whose value is ever increasing. On the Bunter sandstone formation which predominates in the Solling, extremely good masts alone produce results, and these occur on an average every 8 years. Quarter masts produce results only on shell-limestone soils.

The failure of reproduction on the sandstone is due to destructive fungi, which thrive in insufficiently decomposed leaf humus. The failure to secure beech reproduction naturally has led to a system of seed fellings based on four preparation fellings extending over a period of 20 years, a seed felling, and final cuttings (light cuttings) extending over the period of regeneration, which is usually 15 years, but which depend on the amount of protection required by the young growth. The shelterwood stand contains on an average two-thirds of the original stand in volume, 20 years before. It is preferred that the soil litter decompose naturally, but advantage must be taken of good seed years, and the humus must often be either raked up into piles or else the soil must be treated artificially by harrowing, plowing, grazing swine, etc. In the preparation-cuttings, protection of the stand against too great an opening, which results in rush and other weeds coming in, is more important than removing forked and other undesirable trees.

The reproduction must be protected during the first few years against raspberry and rush which must be diligently removed, especially during the first year after getting a start. Reproduction from the side ("Randverjüngung") has not proven successful.

The first plantings of oak in the forests of Prussian Solling were pure; after 1840 alternate rows of oak and beech were planted, but this proved a failure since the beech crowded out the oak. Better results were later secured by planting the beech as an understory after the oak had secured a sufficient start to prevent its being crowded out. After considerable experimenting, the establishing of oak in beech forests was effected chiefly by sowing or planting seedling stock according to the Martzfield process in stands in which the beech had been clear cut to secure reseeding. The high final cost of this process proved its undoing. The present method is to establish oak by dibbling under beech stands at the time of the regeneration cutting or during beech seed years. The oak is allowed to start up with the beech reproduction to prevent its destruction by game, which is a serious menace to oak reproduction in this region and advance beech saplings are cut down so as not to interfere with the oak. Wherever dominant oaks are found in the Solling in equal-aged mixture with beech, two facts are most evident: the site is exposed to the sun and the oak is *Q. sessiliflora*. This oak is favored over *Q. pedunculata* since it has a shallow root system, will thrive in shallow soils and mixes better with beech. To insure a successful mixture, it is of

primary importance to have a sunny site; on cool, shaded sites the oak is always suppressed. The planting of single oaks in preference to rows or groups is not recommended for two reasons; the oak is sentimentally favored in cutting contrary to the best economic results, and when the stand is opened the trees develop trunk sprouts and invariably become stag-headed. It is of primary importance not to plant oak in advance of the beech seeding, since a "green" forest floor is necessary to protect the oak seedlings from extermination by game animals.

J. R.

Müller. *Forstliche Mitteilungen aus dem Preussischen Solling.* Zeitschr. Forst-u. Jagdw., 51:225-247, 301-307. 1919.

Sowing or Planting?

The question asked in the title ("What is the present style: Sowing or planting?") explains a condition which has been all too evident in German forestry. The present style establishes the present practice of reproducing new stands, and the more striking a new idea is, the quicker it is put into use, and it stays in use until a newer idea completely supersedes it, and any desirable points in the first idea, instead of being fostered, are dropped in toto with the old idea. The style at present, with large areas of cut-over land lying bare and man-power scarce, is plowing and sowing with drill machines. Failures must be replaced by planting. When the present post-war conditions gradually disappear, planting will again come into its own. The pine is a cultural plant, that is, with the present objects of management (a closed, clean-boled stand) in view, nature cannot provide conditions ideal for pine reproduction and culture must combat nature to secure a new stand of pine. Natural regeneration is secured only after heavy seed years on completely open areas, or in openings only under side shading. Artificial sowing is successful only when the seedlings will have a continuous moisture supply, so that the tap root can push through the humus, which plays an important part in determining the success of efforts to reproduce the stand, and secure a hold in the soil. Ordinarily, the seedling under the influence of the humus layer develops a superficial root system and easily succumbs during periods of drought. Planting does away with this; not only does the seedling develop a deep root system but the loosened soil in the hole is an excellent moisture reservoir and medium for transferring moisture into the lower soil through the upper, more or less impervious sub-soil.

Experiments by the author show that planting with a semi-conical spade produces better plants and is cheaper than the other more elaborate planting methods and that the cost of planting, calculated through the first three years is actually less than the cost of sowing. Like Burkhardt, he concludes that natural regeneration has its rightful sphere as has sowing and planting; but that, in general, artificial culture has progressed far in advance, and now is passing out of the sowing stage into that of the higher forest industry, namely planting.

J. R.

Kienitz, M. *Was ist denn jetzt Mode: Saat oder Pflanzung?* Zeitschr. Forst-u. Jagdw., 51:417-436, fig. 1-9. 1919.

Studying the Larch

From studies of the larch outside of its native habitat, several German foresters have concluded that depth of soil is an important factor in governing the degree of thrift and range of this tree. However, it thrives very often on very shallow soils in the Canton Uri, Switzerland, where it grows naturally. Such terrain in itself offers no inducement to the growth of the tree; the governing factor is a plentiful and permanent supply of soil moisture. The fact that the larch prefers north slopes to southerly exposures in spite of its great demand for light, tends to explain the great moisture demand of this tree. It overcomes surface dryness, through its deep growing main root, and subsidiary "Senkerwurzel" which often attain a length of 9 meters. The enormous water requirement further is necessary because of the very heavy water loss through transpiration, as compared with spruce, pine, beech, etc. This explains the fact that the tree is the only native conifer which sheds its foliage in the winter, and this is done to avoid a conflict between transpiration and reduced water absorption. In extraordinary drought periods, larch saves itself by its capability of shedding its foliage, while other conifers lose considerable through death. Gunnar's two species of larch—the Tirolian species and the species growing in Scotland and Silesia—are but varieties as determined by moisture supply. The latter variety is found on much drier sites and has a very open crown. Its transpiration space must be limited to the minimum or else the tree would not be able to survive. The fact that larch will not grow in mixture with Norway spruce (*Picea excelsa*) even though it grows faster in youth, is not due to greater intolerance, but because the heavy crown cover of spruce on the one hand prevents precipitation

from reaching the soil, while the shallow wide-spreading net work of roots absorbs the penetrating moisture and gradually produces a condition of ever increasing dryness at the lower soil levels. Larch, however, thrives excellently in mixture with pine and beech, since neither of these offers a great mechanical hindrance to precipitation reaching the surface of the ground, and neither competes with its deeper root systems with the larch for moisture as does the spruce. In beech stands, the humus layer of leaves, furthermore, is an excellent guard against surface desiccation. In general, it must be considered that a plentiful water supply means more to the larch than has been heretofore commonly supposed. J. R.

Fankhauser. *Zur Kenntnis der Lärche.* Zeitschr. Forst-u. Jagdw., 51:289-297, fig. 1-3. 1919.

MENSURATION, FINANCE, AND MANAGEMENT

Why a Timber Survey?

Of 822,000,000 acres original forest area, the United States has left 137,000,000 acres of virgin timber. Twenty-six billion cubic feet are cut or destroyed annually, and only 6 billion cubic feet grow to replace them. The per capita lumber consumption has decreased from 515 board feet, the crest of our utilization in 1906, to 300 board feet in 1918. If we must reduce to 150 board feet per annum, as in Germany before the war, or to 220 board feet, as in England, it will evidently be necessary to pay either in excessive prices or by dispensing with products essential for reasonable standards of living. Fifteen per cent of our timber supplies, and 50 per cent of our timber consumption, is in the Northeastern States centering 2,500 miles from the Pacific Coast States where 50 per cent of the timber supplies, and less than 10 per cent of the timber consumption, is localized. The Northwest is the only timber region which promises to cut more than local requirements in 1930. No attempt has been made to bring together producer and consumer for an intelligent consideration of the utilization of the present resources and the plans for production of future resources. The lack of authoritative detailed information has forced the consideration of a timber survey to secure data needed by forest owners, businesses, industries, and the public. It would serve as a basis for plans for growing adequate and suitable supplies where and when they are needed. Such a survey should include statements of the remaining timber, mature and second growth, merchantable and unmerchantable,

by species, quantities, and acreages, with indications of location and availability for use. We should know the drain upon this resource by species, quantity, quality, regions, and agencies. Requirements should be ascertained by industries, classes of consumers, regions, species, quantity, quality, and location. We must know the current rate of growth in volume by species, types, quality, and location of their probable yields. More exact knowledge is needed of the amount of land available, chiefly suitable for forest production in different regions.

J. K., Jr.

Clapp, Earle H. Lumber, 871:53-57. 1921.

Forestry Personnel in Greece

The forest administration has been handicapped since its inception (1836) by the lack of trained personnel. Forest protection has been in charge of local police officials, and local financial officers issue cutting permits and conduct sales. The foresters (Oberförster) include provincial police officers, who are now required to have a three months' training in forestry, and some 30 professional foresters (out of 105 in all), who have had a short training at various Austrian schools. The first school of forestry was established in 1896 at Vytina and serves principally for training forest guards. A school forest of 16,000 hectares (chiefly *Abies cephalonica*) serves as a field for practical training. Two other similar schools are to be established—one in the Aleppo pine forest Chalandrion in Attica, the other in the hardwood forest Agyia, in the Mt. Olympus region. For training the administrative personnel, the State sends a certain number of students each year to Austria. The law of 1917 provides for a higher forest school at Athens, to give a complete four-year course. The curriculum is described. The number of students, fixed by the Minister of Agriculture, has so far been from 15 to 25 each year.

W. N. S.

Sklawunos, C. G. *Die Organization des Forstpersonals in Griechenland und dessen Ausbildung.* Forstwiss. Centralbl., 42:443-450, 1920.

Forests and Grazing

Individual trees, and still more groups of trees, are beneficial to grazing in mountainous regions because they break the force of the winds, moderate extremes of temperature, increase the relative humidity of the air and the formation of dew, decrease evaporation, and favor the propagation of the best forage plants. Trees are also

necessary in such regions for the production of both timber and fuel. Differences of opinion exists as to whether trees, either singly or in groups, are more beneficial when scattered through the grazing areas or when segregated into distinct stands confined to the more exposed and least favorable sites and not open to grazing. The author adheres strongly to the latter view, and believes that the use of forests for grazing is detrimental to the best development of both trees and forage. France has so far paid too little attention to this very important problem, often with disastrous results. S. T. D.

Cardot, E. *La question sylvo-pastorale.* Rev. Eaux et Forêts, 58:323-329, 1920.

POLITICS, EDUCATION, AND LEGISLATION

Teaching Forestry in the Woods

The State Forestry Academy, at Mont Alto, in the mountains of southern Pennsylvania, has a working tract of 23,000 acres of mixed hardwood and coniferous forest. Over 100 species of native trees and shrubs occur within one mile of the Academy. The attendance has been limited to citizens of the State who intended to enter the service of the State after graduation. This has assured a constant source of properly trained men for the service. The forest plantations, from 1 to 20 years in age, amount to 600 acres, with a nursery of a yearly capacity of 3 million seedlings. Five native pines occur on this tract, including shortleaf pine (*Pinus echinata*), which here reaches its most western extension north of Mason and Dixon's line. J. K., Jr.

Kellogg, R. S. Lumber, 878:19-20, 1921.

EDITORIAL COMMENT

Hands Off the National Forests

There is every reason against, and none in favor of, the various bills now before Congress proposing to transfer the National Forests to the Interior Department. Two of these bills—the Cummins and the New bills—affect only the National Forests of Alaska. A third bill, introduced by Senator King of Utah, proposes to transfer all the National Forests to that Department. The friends of forestry must be up and doing lest quiescence should be mistaken for assent or lest public apathy be taken advantage of by interests unfriendly to conservation.

It is significant that none of these bills has come to life under the auspices of the known and trusted friends of forestry. It is safe to say that the foresters of America will solidly unite against these measures. Besides this body of specialists who know the subject thoroughly, there is a vast mass of public opinion that will resent any tampering with a tried and tested institution.

It is possible that attempts will be made to allay public apprehension as to the real motives of these measures by representing them as a step in the reorganization of the government departments. Towards a sound, scientific reorganization every good citizen will show only approval; but there will be no patience with amateur or devious tam- Forestry is one of the great branches of agriculture, as was properly and, let us hope, finally recognized in 1905, when the National Forests were transferred from the Interior Department, on its own confession of inability to handle them, to the Department of Agriculture. To transfer them back again now would be not reorganization, but folly.

The National Forests are engaged primarily in growing timber, and they grow timber by means analogous to those used in growing farm crops. The National Forests are living organisms capable of continuous growth and production, and they should be kept so. Forestry, being an agricultural enterprise, needs the scientific outlook, the scientific equipment, and the great tradition of productive scientific effort so admirably embodied in the Department of Agriculture.

The Interior Department is not fitted and was never designed to manage lands as a means of production. In its primary functions it is the Government's real estate agent and abstractor of titles. Its whole tradition is based on passing title to the public lands into private hands. At the only place where it creatively touches agriculture—namely, in the Reclamation Service—its function is an engineering one. It is no detraction from the usefulness or the reputation of the Department to say that it is not fitted, either by tradition, by outlook, or by logical function, to manage a great and highly complex agricultural enterprise.

The American people should demand and receive honest, unequivocal answers to the following questions:

In what way would the National Forests be benefited by the proposed transfer?

In what way would the American people be benefited by it?

What changes in the present administration and development of the National Forests would be made in the event of the transfer? What would be the purpose of those changes?

Men of influence should make the necessary personal sacrifice to protest at the public hearings on these bills, and individuals and associations interested in any phase of conservation—whether of forests, game, water power, or other resources—should bring their full weight to bear against these mischievous measures. Now is the time for such decisive action, such overwhelming protest, that the foes of conservation will not lift their heads for another decade.

The two Alaskan bills—S. 2382 and S. 2203—were referred to the Senate Committee on Territories and Insular Possessions. The King bill, S. 2740, was referred to the Senate Committee on Public Lands and Surveys, of which Senator Smoot is chairman.

NOTES

Annual Meeting of the North Carolina Forestry Association at Wilmington

The eleventh annual convention of the North Carolina Forestry Association will be held in Wilmington, North Carolina, on Friday, January 27, 1922. The program is being arranged so that several of the most important forestry problems now before the people of the State, such as highway planting, county cooperation in forest fire prevention, State or Federal forest control, etc., will be brought up for discussion by some of the leading authorities on these subjects. A plan is also on foot to organize an excursion the following day into the longleaf pine forests of New Hanover County. Within ten miles of Wilmington are to be found some of the best second-growth longleaf pine forests in the State, and an opportunity will be given for out-of-town delegates to visit them.

SOCIETY AFFAIRS

Southern Appalachian Section of Society Being Organized

At a meeting held in Asheville, N. C., October 28 and 29, the decision was reached to organize a Southern Appalachian Section of the Society. The proposed Section will cover the region centering about the southern Appalachian mountains.

A petition, together with the by-laws of the proposed Section, has been submitted to the Executive Council of the Society for approval. Officers elected for the ensuing year are as follows: Chairman, J. S. Holmes; vice chairman, Verne Rhoades; secretary, C. F. Korstian.

The entire session on October 29 was devoted to a symposium on minimum silvicultural and protective requirements. The following papers were presented:

"The State and Minimum Silvicultural and Protective Requirements," by J. S. Holmes, State Forester of North Carolina.

"The Private Timberland Owner and Minimum Silvicultural and Protective Requirements," by W. J. Damtoft, Champion Fiber Company.

"National Forest Administration and Minimum Silvicultural and Protective Requirements," by Ira T. Yarnall, Pisgah National Forest.

"Problems in the Minimum Silvicultural and Protective Requirements Study," by E. F. McCarthy, Appalachian Forest Experiment Station.

A very interesting discussion followed the symposium, in which about fifteen members and friends of the Society participated.

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